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STATE OF INDIANA

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INDIANA UTILITY REGULATORY COMMISSION

INDIANA UTILITY REGULATORY COMMISSION

PETITION OF THE CITY OF ELKHART, INDIANA, FOR AUTHORITY TO INCREASE ITS RATES AND CHARGES FOR WATER SERVICE, AND FOR APPROVAL OF NEW SCHEDULE OF RATES AND CHARGES APPLICABLE THERETO	)))))))	**CAUSE NO. 43191**

PETITIONER'S SUBMISSION OF CASE-IN-CHIEF

Petitioner City of Elkhart submits herewith the prepared testimony and evidence constituting its case-in-chief for this matter.

Nicholas K. Kile (Atty. #15203-53)
P. Jason Stephenson (Atty. # 21839-49)
Yolanda D. Edwards (Atty. # 24161-49)
BARNES & THORNBURG LLP
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Indianapolis, Indiana 46204
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Attorneys for Petitioner
City of Elkhart, Indiana

CERTIFICATE OF SERVICE

The undersigned hereby certifies that two copies of the foregoing document were served this 7th day of February, 2007, by hand delivery to the following:

Office of the Utility Consumer Counselor
100 North Senate Avenue, Room N501
Indiana Government Center North
Indianapolis, Indiana 46204,

____

Petitioner's Exhibit SAM-1

IURC Cause No. 43191

Elkhart (Indiana) Municipal Water Utility

Testimony of Scott A. Miller, C.P.A.

On Behalf of Petitioner

February 7, 2007

H.J. Umbaugh & Associates
Certified Public Accountants LLP
Indianapolis, Indiana

STATE OF INDIANA

INDIANA UTILITY REGULATORY COMMISSION

IN THE MATTER OF THE PETITION	)	
OF THE CITY OF ELKHART,	)	CAUSE NO. 43191
INDIANA, FOR AUTHORITY TO	)	
INCREASE IT RATES AND	)	
CHARGES FOR WATER SERVICE	)	
AND FOR APPROVAL OF NEW	)	
SCHEDULE OF RATES AND	)	
CHARGES APPLICABLE THERETO	)	

VERIFIED DIRECT TESTIMONY
of
SCOTT A. MILLER, C.P.A.

February 7, 2007

On Behalf of Petitioner
Elkhart (Indiana) Municipal Water Utility

Petitioner's Exhibit SAM-1

Q. Please state your name and business address.

A. My name is Scott A. Miller and my business address is 8365 Keystone Crossing, Suite 300, Indianapolis, Indiana 46240-0458.

Q. What is your profession and for whom are you employed?

A. I am a Certified Public Accountant and a principal in the firm of H.J. Umbaugh & Associates, Certified Public Accountants, LLP ("Umbaugh").

Q. Can you describe your firm and its area of expertise?

A. Umbaugh is a firm of Certified Public Accountants practicing exclusively as independent financial advisors and utility consultants. The firm, in existence for over fifty (50) years, is a regional CPA firm with offices in Indianapolis and Plymouth, Indiana and Lansing, Michigan. Our firm has concentrated its practice in providing financial advisory services to various governmental entities and not-for-profit utilities within the State of Indiana. A large part of our practice involves accounting studies in connection with changes in utility rates and financial planning for the issuance of tax-exempt bonds and other evidences of indebtedness.

Q. What is your educational experience?

A. In June 1995, I received a Bachelor of Science Degree from the Indiana University Kelley School of Business in Bloomington, Indiana. Since then I have completed numerous professional courses sponsored by the American Institute of Certified Public Accountants, the Indiana CPA Society and other professional organizations.

Q. Please describe your relevant professional experience.

A. I joined the firm of Umbaugh in June 1995 and, in 1998, completed the requirements to become licensed as a Certified Public Accountant in the State of Indiana. On July 1, 2005, I became a principal in the firm. During the past eleven years with Umbaugh, I have been involved with many professional engagements including financial studies for municipally-owned water, electric, gas and sewage utilities, not-for-profit water corporations, water authorities, regional water and sewer districts and conservancy districts. These studies quite often have involved the determination of utility revenue requirements, cost of service studies and the financial planning associated with the issuance of tax-exempt bonds and other forms of indebtedness. I have given speeches and participated in panels and workshops concerning utility rates, financing and project development before the Indiana Rural Water Association, the Alliance of Indiana Rural Water, the Indiana Section of the American Water Works Association, the Indiana Association of Sewer Companies, the Indiana Water Environment Association, and the Indiana Association of Cities and Towns.

Q. What professional organizations are you associated with?

A. I am a member of the American Institute of Certified Public Accountants, The Indiana CPA Society, the Indiana Water Environment Association and the American Water

Works Association and our firm is a member of both the Indiana Rural Water Association and the Alliance of Indiana Rural Water. In addition, our firm is the financial advisor to the Indiana Association of Cities and Towns. In this capacity, we provide guidance on financial matters that affect communities across the State.

Q. Have you testified before as an expert witness?

A. Yes, I have testified before the Indiana Utility Regulatory Commission on many previous occasions.

Q. Was your firm retained by the Elkhart Municipal Water Utility (the "Utility" or "Petitioner") in connection with these proceedings?

A. Yes. We were retained by the Utility to advise them on rate and financing options in light of their desire to construct certain improvements to the waterworks system.

Additionally, we were retained to complete an accounting study to determine the rates necessary to support the pro forma revenue requirements and make recommendations regarding changes in Petitioner's present schedule of rates and charges for service.

Q. Have the results of your analysis been summarized in a written report?

A. Yes. Our firm prepared an Accounting Report dated February 7, 2007 summarizing the results of our studies.

Q. Please identify Petitioner's Exhibit SAM-2

A. Exhibit SAM-2 is a copy of our Accounting Report summarizing the results of the accounting services performed for Petitioner.

Q. Was the Accounting Report prepared by you or under your supervision?

A. Yes.

Q. Please explain how the Accounting Report is organized.

A. The Accounting Report is divided into four sections. The first section of the report is the accountant's letter which describes that the type of accounting service provided was a compilation and that the resulting Accounting Report is a special purpose report for submission to the Indiana Utility Regulatory Commission and is restricted to that purpose only. This letter is incorporated by reference on all the pages of the Accounting Report.

The second section of the report (pages 2 and 3), sets forth the general comments, which help to explain and describe certain assumptions made, and the resulting findings derived from the various schedules.

The third section of the report (pages 4 through 18), contains pro forma financial information for the 12 months ended August 31, 2006, which was the test year used to develop the proposed rates and charges. Page 4 summarizes the annual requirement for capital improvements over the next four years. In addition to the average annual level of normal capital improvements, the Utility has identified a capital improvement plan consisting of major projects that need to be completed. Pages 5 through 13 set forth the various calculations of the Utility's pro forma cash operating expenses. Pages 14 and 15 contain the Utility's annual operating revenues at existing rates and summarize the pro forma annual revenue requirements and available revenues included in this Cause. Finally, pages 16 through 18 show a comparison of the Utility's present rates and the rates proposed in this Cause.

The fourth section of the Accounting Report (pages 19 to 29) contains additional unaudited financial information regarding the test year and comparative financial information for calendar year 2005. In addition, we have compared the Utility's cash and investment account balances at the end of the test year with the requirements stated in the existing bond ordinance. We have also prepared an amortization schedule of the Utility's outstanding bonds. Finally, we calculated the average annual additions to utility plant in service as well as depreciation expense based on a composite rate of 2.0%.

Returning to the pro forma calculations, page 4 presents the four-year capital improvement plan proposed by Utility management and sponsored by Petitioner's witness Mr. Eric Horvath. The average annual level of normal capital improvements has been added to the projects proposed in the four-year plan to arrive at the total capital requirement per year. The total capital requirement has been reduced by the amount of funds on hand in the Utility's Depreciation Fund over and above the suggested minimum balance. Pages 5 and 6 of the report show the test year cash operating expenses, including taxes, and the adjustments which have been made to arrive at the pro forma annual cash operating expenses. Each of the adjustments is explained in detail on pages 7 through 13 of the report. Adjustments have been made to reflect current price levels for labor, employee benefits, taxes and insurance. In addition, adjustments have been made to provide for periodic costs such as filter and storage tank maintenance, rate case expense and to eliminate costs considered to be capital or non-recurring in nature. Finally, an adjustment was made to provide for pro forma IDEM annual fees.

Pages 14 and 15 summarize the pro forma revenue requirements of the Petitioner. The pro forma revenue requirements incorporate the Petitioner's adjusted operation and maintenance expenses as shown on pages 5 through 13. The debt service requirement of $883,588 per year has been included to provide funds for the annual principal and interest payments of the outstanding bonds. Finally, the revenue requirements provide $3,632,090 as an allowance to fund extensions and replacements to utility plant. This allowance is based on the average annual additions to utility plant and the Utility's capital improvement plan shown on page 4. The total annual net revenue requirements have been projected at $8,241,290, after deducting test year other operating revenues and interest earnings.

In order to provide sufficient revenues to meet the pro forma annual revenue requirements, the current annual revenues shown would need to be increased by $2,734,156, or approximately 49.28% percent across-the-board. While pro forma revenue requirements support a 49.28% across-the-board increase, the Elkhart Common Council has only authorized a 45.00% across-the-board increase at this time.

Pages 16 through 18 of the report summarize the present and proposed water rates and charges. The rates proposed include a volumetric rate, a monthly service charge based on the customer's meter size, a monthly minimum fee and monthly fire protection charges.

The final section of the Accounting Report contains unaudited supplemental financial information for the test year, together with comparative financial information for calendar year 2005. In addition, we have provided a comparison of cash balances required per the current bond ordinance, an amortization schedule for the outstanding bond issue and a calculation of the average annual additions to utility plant and calculated depreciation expense.

Q. Please explain the adjustment to payroll expense.

A. The adjustment for pro forma salaries and wages expense reflects the 2007 pay rates for union employees authorized in the existing agreement between the City of Elkhart and the Teamsters Local Union No. 364. This agreement is in effect until December 31, 2008, although 2008 pay rates have not been established. Salaries and wages for non-union employees have been normalized at approved 2007 pay rates. In addition, adjustments were made to normalize for the anticipated hours that each employee will work and to reflect management's intent to fill three positions open at the end of the test year. These adjustments result in an increase in payroll expense of $63,820 over test year levels.

Q. Please explain the adjustment to employee benefits expense.

A. Adjustment 2 on pages 7 and 8 of the accounting report reflects the current premium levels for health and life insurance. In addition, the adjustment provides for the 2007 PERF rate as well as pro forma FICA expense based on the pro forma payroll calculations.

Q. Please explain the adjustment for periodic filter maintenance.

A. This adjustment provides for the replacement of the Utility's filter media every 20 years. Currently, the Utility maintains four 8' diameter X 40' long horizontal pressure filters and two 10' diameter X 50' long horizontal pressure filters. The estimated cost includes the removal of the existing filter media and support gravels, the replacement of underdrain nozzles, the installation of new support gravels, the replacement and installation of new airscour piping and the installation of new filter sand and anthracite. This total cost has been amortized over 20 years.

Q. Please explain the reduction in operating expenses for non-recurring or capital items.

A. Four Thousand Nine Hundred Fifty Dollars ($4,950) in test year operating expenses were removed as capital items. That amount reflects the purchase of a new Air Drive and Torque Gauge.

Q. Please explain the adjustment for periodic tank painting.

A. This adjustment will continue to provide funds for the Utility to periodically paint the interior and exterior of its water storage tanks. Currently, the Utility maintains three ground storage tanks and four elevated storage tanks. In addition, the four-year capital improvement plan calls for the construction of two new elevated storage tanks. Currently, the Utility maintains a segregated cash account for tank painting. This total cost has been amortized over 15 years. The proposed annual requirement will allow the utility to continue funding this account while at the same time using cash on hand in the account to pay for periodic tank painting expense. By self-funding this expense in a revolving account, the Utility will mitigate the impact on rates of these large periodic expenses.

Q. Have you offset the current balance in the restricted account against the annual amortization?

A. No, and to do so would not be appropriate. The Utility will only be recovering the annual allocation each year, which must be set aside to use when the tanks are painted. If we reduced the annual allocation for the amounts that have already been accumulated, not enough will have been recovered when it is time to paint the tanks.

Q. Please explain the rate case expense adjustment.

A. Test year operating expenses were adjusted to reflect a five-year amortization of the estimated rate case expenses associated with this proceeding.

Q. Please explain the adjustment to payment in lieu of property taxes.

A. Elkhart Municipal Water Utility makes payments in lieu of property taxes to the civil City of Elkhart. Adjustment 7 on page 12 reflects the value of Petitioner's utility plant in service at the end of the test year less the accumulated depreciation for the same time period resulting in net utility plant of $34,865,761. Management estimates that approximately 26% of the utility plant in service is outside the corporate limits and thus not subject to the corporate tax rate. Using the 2005 payable 2006 tax rate, results in payments in lieu of property taxes of $296,045.

Q. Please explain the adjustment to insurance expense.

A. Adjustment 8 on page 13 reflects the anticipated allocation of current premium levels for the City's various insurance policies to the Petitioner. The adjustment results in a net increase in pro forma expense of $170,000.

Q. Please explain the adjustment for Indiana Utility Receipts Tax.

A. Test year Utility Receipts Tax has been normalized to reflect the pro forma level of revenues at current rates.

Q. Please explain the adjustment for IDEM regulatory fees.

A. Test year expense has been adjusted to reflect the current number of customer connections subject to the IDEM regulatory fee of $0.95 per connection per year.

Q. Is it your belief that the adjustments to test year expenses and revenues contained in your report are fixed, known and measurable?

A. Yes, it is.

Q. Does this conclude the explanation of the Accounting Report?

A. Yes it does.

Q. Is it your opinion that the proposed level of revenues shown in your report is reasonable and necessary to meet the pro forma revenue requirements of the utility?

A. Yes, it is my opinion that it is.

Q. In your opinion, are the rates proposed fair, just and non-discriminatory?

A. In my opinion they are.

Q. Would you please describe Petitioner's Exhibit SAM-3?

A. Petitioner's Exhibit SAM-3 is the revised water rate ordinance adopted by the Elkhart Common Council on August 7, 2006. The water rates and charges contained in Ordinance No. 4978 reflect the 45% across-the-board increase proposed by Petitioner in this case.

Q. Does this conclude your direct testimony in this Cause?

A. This concludes my direct testimony at this time.

AFFIRMATION

I affirm under the penalties for perjury that the foregoing testimony is true to the best of my knowledge, information, and belief.

Signed: ______________________________

Printed: Scott A. Miller

Petitioner's Exhibit SAM-2

IURC Cause No. 43191

Elkhart (Indiana) Municipal Water Utility

Accounting Report On Proposed Increase in Rates and Charges

February 7, 2007

H.J. Umbaugh & Associates
Certified Public Accountants LLP
Indianapolis, Indiana

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It's all about experience.

February 7, 2007

Honorable David L. Miller, Mayor and
Members of the Common Council
City of Elkhart
229 South Second Street
Elkhart, Indiana 46516

In connection with the proposed increase in the Utility's schedule of water rates and charges, we have, at your request, compiled this special purpose report for submission to the Indiana Utility Regulatory Commission.

This report has been compiled for the purpose of requesting approval of a new schedule of water rates and charges from the Indiana Utility Regulatory Commission and should not be used for any other purpose.

In the preparation of this report, certain financial information for the twelve months ended August 31, 2006 was obtained from the records of the Utility, without audit or review, and accordingly, we express no opinion or any other form of assurance thereon. Further, the pro forma financial information in this report is based upon unaudited financial information for the twelve months ended August 31, 2006 and assumptions provided by management and their consulting engineers or obtained from other sources. This pro forma financial information is prepared for the purpose of showing the estimated financial effects on the utility's revenue and revenue requirements of an increase in rates and charges for service and other changes that may be reasonably fixed, known or measured, excluding provisions for future inflation. The actual results achieved may vary from the pro forma information and the variations may be material. We have no responsibility to update this report for events and circumstances occurring after the date of this report.

The summarized historical financial statements for the twelve months ended December 31, 2005, August 31, 2006, and supplemental data, were taken from the Utility's internal statements. They are presented as supplemental data and are not intended to constitute an adequate presentation of the financial position, the results of operations nor cash flows in accordance with generally accepted accounting principles. They have not been audited or reviewed by us, therefore, we do not express an opinion or any other form of assurance thereon.

Umbaugh

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ELKHART MUNICIPAL WATER UTILITY

GENERAL COMMENTS

ELKHART (INDIANA) MUNICIPAL WATER UTILITY

GENERAL COMMENTS

The City of Elkhart, located in Elkhart County, Indiana, owns and operates a water utility and furnishes retail water service and fire protection to the residents of the City and the surrounding area.

In order to provide sufficient revenues for the anticipated costs of operation and maintenance, for the payment of principal and interest on the existing indebtedness, and for replacements and improvements to utility plant, the Common Council of the City of Elkhart proposes to increase water rates and charges, subject to the approval of the Indiana Utility Regulatory Commission.

PRO FORMA FINANCIAL INFORMATION

Calculation of Annual Allowance For Replacements and Improvements – Page 4

In addition to the Utility's normal annual replacements and improvements management has identified several large capital improvement projects that will need to be completed in the next 4 years. The Utility has budgeted these projects by year, and provided descriptions and cost estimates as shown on this page. By taking into account on-going capital needs combined with the specific major projects identified, a four-year average for replacements and improvements is calculated in order to produce an annual amount required of $3,632,090.

Pro Forma Annual Operating Expenses – Pages 5 - 13

The recorded cash operating expenses for the twelve months ended August 31, 2006 have been adjusted for fixed, known and measurable changes as explained on pages 7 through 13 to arrive at the pro forma annual operating expenses. Significant among the adjustments are periodic maintenance requirements, payroll disbursements, employee benefits and other fixed, known and measurable changes. The adjustments exclude a provision for future inflation.

Pro Forma Annual Revenue Requirements and Available Revenues – Pages 14 – 15

The recorded cash operating expenses for the twelve months ended August 31, 2006, have been adjusted for expected changes as explained on pages 5 through 13 to arrive at the pro forma annual operating expenses. The annual debt service requirement reflects the average annual principal and interest payments on the outstanding loans and bonds. The annual requirement for extensions and replacements to utility plant is shown on page 4.

The pro forma deficiency of revenues as compared to pro forma revenue requirements amounts to approximately $2,734,156 which results in a 49.28% calculated increase in present rates. At this point in time, the Utility is only requesting a 45.00% across-the-board increase in conjunction with this cause.

(Continued on next page)

GENERAL COMMENTS

PRO FORMA FINANCIAL INFORMATION (Cont'd)

Schedule of Present and Proposed Water Rates and Charges – Pages 16 – 18

This schedule compares the rates currently being charged by the water utility with the proposed rates necessary to fund the pro forma revenue requirements.

ELKHART MUNICIPAL WATER UTILITY

PRO FORMA FINANCIAL INFORMATION

ELKHART (INDIANA) MUNICIPAL WATER UTILITY

CALCULATION OF ANNUAL ALLOWANCE FOR REPLACEMENTS AND IMPROVEMENTS
(Provided by Utility Management)

	Estimated Project Year			
	2007	2008	2009	2010
Average annual additions to utility plant (pg 29)	$480,290	$480,290	$480,290	$480,290
Scheduled additional capital projects				
North main pump station rehabilitation	1,300,000			
Northeast elevated storage tank (1 MG) - design	172,650			
Supervisory control and data acquisition upgrades	20,000			
Ash road 16" river crossing - US 20 to CR 16	679,090			
Hubbard Ave. revitalization - water main replacement	315,000			
Hudson St. - water main replacement	445,000			
Northeast elevated storage tank (1 MG) - land acq.		40,000		
Southeast elevated storage tank (.75 MG) - design		172,650		
Beardsley Ave. revitalization - water main replacement		360,000		
Crawford St. revitalization - water main replacement		330,000		
Johnson St. widening - new 20" water main		510,000		
Northeast elevated storage tank (1 MG)			2,129,350	
Southeast elevated storage tank (.75 MG) - land acq.			40,000	
Kilbourn Ave. revitalization - water main replacement			435,000	
Fulton St. revitalization - water main replacement			640,000	
24" water main - CR 13 loop			1,726,500	
24" river crossing @ Okema & Edgewater			345,300	
24" water main - Rainbow Bend & Dorsey			471,910	
Southeast elevated storage tank (.75 MG)				1,553,850
S. Michigan St. - water main replacement				415,000
24" water main - SR 19 from Lusher to Franklin				354,075
24" water main - Pennsylvania & Okema				805,700
Totals	$3,412,030	$1,892,940	$6,268,350	$3,608,915

Total requirements	$15,182,235
Less available depreciation cash	(653,874)
Net requirement	14,528,361
Divide by 4 years	4
Average annual requirements	$3,632,090

(The Accountants Compilation Report and accompanying comments are an integral part of this statement.)

ELKHART (INDIANA) MUNICIPAL WATER UTILITY

PRO FORMA ANNUAL OPERATING EXPENSES
See Explanation of Adjustments, pages 7 - 13
No inflation adjustment made.

Lab and Pretreatment	12 Months Ended 08/31/06 (Unaudited)	Adjustment	Ref	Pro Forma
Salaries and wages	$46,027	$2,355	(1)	$48,382
Employee benefits	9,193	1,935	(2)	11,128
Materials and supplies	10,951			10,951
Transportation	50			50
Contractual services	3,796			3,796
Testing	32,135			32,135
Rent	952			952
Miscellaneous	515			515
Sub-totals	103,619	4,290		107,909
Water Treatment				
Salaries and wages	473,158	24,194	(1)	497,352
Employee benefits	80,584	16,965	(2)	97,549
Purchased power	259,635			259,635
Natural gas	52,789			52,789
Materials and supplies	62,086			62,086
Chemicals	68,526			68,526
Contractual services	144,000	9,825	(3)	153,825
Miscellaneous	6,335			6,335
Sub-totals	1,147,113	50,984		1,198,097
Transmission and Distribution				
Salaries and wages	293,103	14,991	(1)	308,094
Employee benefits	100,864	21,230	(2)	122,094
Purchased power	7,239			7,239
Materials and supplies	204,916	(4,950)	(4)	199,966
Contractual services	75,126	191,669	(5)	266,795
Transportation	538			538
Miscellaneous	3,141			3,141
Sub-totals	$684,927	$222,940		$907,867

(Continued on next page)

(The Accountants Compilation Report and accompanying comments are an integral part of this statement.)

ELKHART (INDIANA) MUNICIPAL WATER UTILITY

(Cont'd)

PRO FORMA ANNUAL OPERATING EXPENSES

See Explanation of Adjustments, pages 7 - 13

No inflation adjustment made.

	12 Months Ended 08/31/06 (Unaudited)	Adjustment	Ref	Pro Forma
Customer Accounts				
Salaries and wages	$115,413	$5,903	(1)	$121,316
Employee benefits	29,330	6,175	(2)	35,505
Materials and supplies	149,506			149,506
Contractual services	18,383			18,383
Transportation	278			278
Miscellaneous	169			169
Sub-totals	313,079	12,078		325,157
Administrative and General				
Salaries and wages	320,276	16,376	(1)	336,652
Employee benefits	75,801	15,955	(2)	91,756
Materials and supplies	12,041			12,041
Utilities	278			278
Contractual services	213,395	40,000	(6)	253,395
Rent	928			928
Transportation	138			138
Payments in lieu of tax	550,005	(253,960)	(7)	296,045
Insurance	130,000	170,000	(8)	300,000
Sales tax	238,572			238,572
Gross income taxes	59,287	15,121	(9)	74,408
Miscellaneous	141,061	1,370	(10)	142,431
Sub-totals	1,741,782	4,862		1,746,644
Totals	$3,990,520	$295,154		$4,285,674

(Continued on next page)

(The Accountants Compilation Report and accompanying comments are an integral part of this statement.)

ELKHART (INDIANA) MUNICIPAL WATER UTILITY

(Cont'd)

PRO FORMA ANNUAL OPERATING EXPENSES
(Explanation of Adjustments)

Adjustment (1)

To adjust test year payroll expense to provide for the 2007 pro forma salaries and wages per the approved union contract dated November 1, 2004.

Pro forma salaries and wages	$1,310,040	
Less test year expense	(1,246,220)	
Adjustment		$63,820

Adjustment (2)

To adjust test year employee benefits expense for pro forma salaries and wages and pro forma employee benefits expense.

Pro forma salaries and wages expense	$1,310,040	
Times 7.65%	7.65%	
Sub-total	100,218	
Less test year expense	(89,891)	
Sub-total		$10,327
Pro forma salaries and wages expense	1,310,040	
Less pro forma part time wages	(18,160)	
Sub-total	1,291,880	
Times 2007 PERF rate	5.50%	
Sub-total	72,052	
Less test year expense	(58,999)	
Sub-total		13,053
Balance carried forward to next page		$23,380

(Continued on next page)

(The Accountants Compilation Report and accompanying comments are an integral part of this statement.)

ELKHART (INDIANA) MUNICIPAL WATER UTILITY

(Cont'd)

PRO FORMA ANNUAL OPERATING EXPENSES
(Explanation of Adjustments)

Adjustment (2) (Cont'd)

Balance carried forward from previous page		$23,380
Pro forma health and life insurance expense	$171,013	
Less test year expense	(137,212)	
Sub-total		33,801
Pro forma wellness expense	14,750	
Less test year expense	(9,670)	
Sub-total		5,080
Adjustment		$62,261

Adjustment (3)

To provide an allowance for periodic filter maintenance expense, per management.

Pro forma annual filter maintenance expense - 8 x 40 horizontal filters	$114,000	
Amortized over 20 years	20	
Sub-total		$5,700
Pro forma annual filter maintenance expense - 10 x 50 pressure filters	$82,500	
Amortized over 20 years	20	
Sub-total		4,125
Adjustment		$9,825

(Continued on next page)

(The Accountants Compilation Report and accompanying comments are an integral part of this statement.)

ELKHART (INDIANA) MUNICIPAL WATER UTILITY

(Cont'd)

PRO FORMA ANNUAL OPERATING EXPENSES
(Explanation of Adjustments)

Adjustment (4)

To adjust the test year for capital or non-recurring items.

Date	Description	Amount
October, 2005	Model P/2 Rev, Air Drive & Torque Gauge	($4,950)

Adjustment (5)

To provide an allowance for periodic tank painting expense, per utility consulting engineer and management.

Ground storage tanks		
Pro forma exterior painting expense	$100,000	
Pro forma floor and sides painting expense	150,000	
Sub-total	250,000	
Amortized over 15 years	15	
Sub-total	16,667	
Times 3 ground storage tanks (each 2 MG)	3	
Sub-total		$50,001
Pro forma interior roof painting expense	$120,000	
Amortized over 10 years	10	
Sub-total	12,000	
Times 3 ground storage tanks (each 2 MG)	3	
Sub-total		36,000
Balance carried forward to next page		$86,001

(Continued on next page)

(The Accountants Compilation Report and accompanying comments are an integral part of this statement.)

ELKHART (INDIANA) MUNICIPAL WATER UTILITY

(Cont'd)

PRO FORMA ANNUAL OPERATING EXPENSES
(Explanation of Adjustments)

Balance carried forward to next page		$86,001
Elevated storage tanks		
Riverview tank - 1 MG		
Pro forma exterior tank painting expense	$180,000	
Pro forma interior tank painting expense	160,000	
Sub-total	340,000	
Amortized over 15 years	15	
Sub-total		22,667
Benham tank - .5 MG		
Pro forma exterior tank painting expense	$150,000	
Pro forma interior tank painting expense	100,000	
Sub-total	250,000	
Amortized over 15 years	15	
Sub-total		16,667
SWF tank - .5 MG		
Pro forma exterior tank painting expense	$100,000	
Pro forma interior tank painting expense	80,000	
Sub-total	180,000	
Amortized over 15 years	15	
Sub-total		12,000
Balance carried forward to next page		$137,335

(Continued on next page)

(The Accountants Compilation Report and accompanying comments are an integral part of this statement.)

ELKHART (INDIANA) MUNICIPAL WATER UTILITY

(Cont'd)

PRO FORMA ANNUAL OPERATING EXPENSES
(Explanation of Adjustments)

Balance carried forward to next page		$137,335
Bower tank - .5 MG		
Pro forma exterior tank painting expense	$100,000	
Pro forma interior tank painting expense	80,000	
Sub-total	180,000	
Amortized over 15 years	15	
Sub-total		12,000
Proposed tank - 1 MG		
Pro forma exterior tank painting expense	$180,000	
Pro forma interior tank painting expense	160,000	
Sub-total	340,000	
Amortized over 15 years	15	
Sub-total		22,667
Proposed tank - .75 MG		
Pro forma exterior tank painting expense	$165,000	
Pro forma interior tank painting expense	130,000	
Sub-total	295,000	
Amortized over 15 years	15	
Sub-total		19,667
Adjustment		$191,669

(Continued on next page)

(The Accountants Compilation Report and accompanying comments are an integral part of this statement.)

ELKHART (INDIANA) MUNICIPAL WATER UTILITY

(Cont'd)

PRO FORMA ANNUAL OPERATING EXPENSES
(Explanation of Adjustments)

Adjustment (6)

To provide an allowance for a utility rate case every five years.

Pro forma utility rate case expense	$200,000	
Amortized over 5 years	5	
Adjustment		$40,000

Adjustment (7)

To provide an allowance for payment in lieu of property taxes ("PILT") to the Civil City.

Utility plant in service and construction work in progress (unaudited)	$46,287,125	
Accumulated depreciation	(11,421,364)	
Estimated Assessed Value	$34,865,761	
Payment in lieu of property taxes based on corporate tax rate of $1.2699 per $100 of assessed value for 2005 payable 2006 taxes (net of property tax replacement credit of $.096438)		$400,061
Inside city water main length (ft.)	1,372,912	
System wide water main length (ft.)	1,855,358	
Estimated utility plant inside city		74%
Pro forma PILT expense		296,045
Less test year expense		(550,005)
Adjustment		($253,960)

(Continued on next page)

(The Accountants Compilation Report and accompanying comments are an integral part of this statement.)

ELKHART (INDIANA) MUNICIPAL WATER UTILITY

(Cont'd)

PRO FORMA ANNUAL OPERATING EXPENSES
(Explanation of Adjustments)

Adjustment (8)

To adjust test year insurance expense for current premiums, per City officials.

Pro forma insurance expense	$300,000	
Less test year expense	(130,000)	
Adjustment		$170,000

Adjustment (9)

To adjust test year Indiana Utility Receipts Tax expense for pro forma expense.

Test year metered revenues	$5,181,483	
Less test year public metered revenues	(279,600)	
Test year fire protection revenues	414,001	
Less exemption	(1,000)	
Sub-total	5,314,884	
Times 1.4%	1.4%	
Sub-total	74,408	
Less test year expense	(59,287)	
Adjustment		$15,121

Adjustment (10)

To adjust test year IDEM regulatory fee expense for pro forma expense.

Current number of water utility connections (as of 8/31/06)	18,968	
Rate per connection	$0.95	
Sub-total	18,020	
Less test year expense	(16,650)	
Adjustment		$1,370

(The Accountants Compilation Report and accompanying comments are an integral part of this statement.)

ELKHART (INDIANA) MUNICIPAL WATER UTILITY

PRO FORMA ANNUAL REVENUE REQUIREMENTS AND ANNUAL REVENUES

See explanation of adjustments, page 15

Annual Revenue Requirements	12 Months Ended 08/31/06 (Unaudited)	Adjustments	Ref.	Pro Forma
Cash operating expenses	$3,990,520	$295,154	(1)	$4,285,674
Debt Service:				
Outstanding 2003 Bonds	884,925	(1,337)	(2)	883,588
Replacements and improvements	1,121,477	2,510,613	(3)	3,632,090
Total revenue requirements	5,996,922	2,804,430		8,801,352
Less interest income	(56,000)		(4)	(56,000)
Less other revenues	(504,062)		(4)	(504,062)
Net Revenue Requirements	$5,436,860	$2,804,430		$8,241,290
Annual Revenues				
Metered revenues	$5,181,483	($46,812)	(5)	$5,134,671
Fire protection	414,001		(4)	414,001
Total available revenues	$5,595,484	($46,812)		$5,548,672
Additional Revenues Required	($158,624)	$2,851,242		$2,692,618
Additional utility receipts tax			(6)	41,538
Total				$2,734,156
Approximate Across-the-Board Percentage Increase Required				49.28%
Across-the-Board Percentage Increase Requested				45.00%

(Continued on next page)

(The Accountants Compilation Report and accompanying comments are an integral part of this statement.)

ELKHART (INDIANA) MUNICIPAL WATER UTILITY

(Cont'd)

PRO FORMA ANNUAL REVENUE REQUIREMENTS AND ANNUAL REVENUES
(Explanation of References)

(1) See "Pro Forma Annual Cash Operating Expenses," pages 5 - 13.

(2) To provide an allowance for outstanding debt service on the Utility's outstanding Waterworks Refunding Revenue Bonds of 2003, see page 28.

(3) To provide an allowance for replacements and improvements based upon the utility's capital improvement plan provided by utility management, see pg 4.

(4) Assumed at test year amounts.

(5) During October, 2006 the former Suburban Utilities, Inc. ("Suburban") customers were converted to City of Elkhart water rates.

Number of former Suburban customers	425	
Times estimated average monthly Elkhart residential bill (667 cubic feet)	$8.54	
Sub-total	3,630	
Times 12 months	12	
Estimated pro forma revenues from former Suburban customers		$43,560
Number of former Suburban customers	425	
Times former minimum bill (1,300 cubic feet)	$17.72	
Sub-total	7,531	
Times 12 months	12	
Estimated test year revenues from Suburban customers		(90,372)
Adjustment		($46,812)

(6) To provide an allowance for additional Indiana utility receipts tax.

Pro forma revenues	$8,282,828
Less exemption	(1,000)
Sub-total	8,281,828
Times 1.4%	1.4%
Sub-total	115,946
Less pro forma utility receipts tax expense	(74,408)
Adjustment	$41,538

(The Accountants Compilation Report and accompanying comments are an integral part of this statement.)

ELKHART (INDIANA) MUNICIPAL WATER UTILITY

SCHEDULE OF PRESENT AND PROPOSED RATES AND CHARGES

Monthly Metered Rates:

Each customer shall be charged the following rates based upon the use of water supplied by the Elkhart Municipal Water Utility. CCF: 100 cubic feet

Block Schedule			Present (1)	Proposed
First	40	CCF	$1.04	$1.51
Next	740	CCF	0.80	1.16
Next	680	CCF	0.64	0.93
Over	1,460	CCF	0.54	0.78

Service Charge:

Each user is subject to the following service charge per month which is added to the volume charge in excess of a minimum user.

5/8	Inch meter	$1.60	$2.32
3/4	Inch meter	1.75	2.54
1	Inch meter	2.15	3.12
1 1/2	Inch meter	3.27	4.74
2	Inch meter	4.83	7.00
3	Inch meter	9.31	13.50
4	Inch meter	15.59	22.61
6	Inch meter	33.51	48.59
8	Inch meter	58.59	84.96

(Continued on next page)

(The Accountants Compilation Report and accompanying comments are an integral part of this statement.)

SCHEDULE OF PRESENT AND PROPOSED RATES AND CHARGES

Minimum Charge

Each user shall pay a minimum charge according to the following meter size for which the user will be entitled to the quantity of water shown for each month. This charge includes the monthly service charge.

		Water Allowed (CCF)	Present	Proposed
5/8	Inch meter	4	$5.76	$8.36
3/4	Inch meter	6	7.99	11.60
1	Inch meter	10	12.55	18.22
1 1/2	Inch meter	20	24.07	34.94
2	Inch meter	32	38.11	55.32
3	Inch meter	60	66.91	97.10
4	Inch meter	100	105.19	152.61
6	Inch meter	200	203.11	294.59
8	Inch meter	320	324.19	470.16

Fire Hydrants

Municipal and Public Fire Hydrants

Each user shall pay a charge according to the following meter size shown below.

		Present		Proposed	
		Annual Charge	Monthly Charge	Annual Charge	Monthly Charge
5/8	Inch meter	$23.52	$1.96	$34.08	$2.84
3/4	Inch meter	25.80	2.15	37.44	3.12
1	Inch meter	32.88	2.74	47.64	3.97
1 1/4	Inch meter	37.56	3.13	54.48	4.54
1 1/2	Inch meter	42.36	3.53	61.44	5.12
2	Inch meter	68.16	5.68	98.88	8.24
3	Inch meter	258.48	21.54	374.76	31.23
4	Inch meter	329.04	27.42	477.12	39.76
6	Inch meter	493.56	41.13	715.68	59.64
8	Inch meter	681.48	56.79	988.20	82.35

(Continued on next page)

(The Accountants Compilation Report and accompanying comments are an integral part of this statement.)

ELKHART (INDIANA) MUNICIPAL WATER UTILITY

(Cont'd)

SCHEDULE OF PRESENT AND PROPOSED RATES AND CHARGES

Fire Hydrants (Cont'd)	Present		Proposed	
Municipal and Public Fire Hydrants	Annual Charge	Monthly Charge	Annual Charge	Monthly Charge
Private Fire Hydrants - Per Hydrant	$239.63	$19.97	$347.52	$28.96
Private Fire Protection Service				
2 Inch line	$26.36	$2.20	$38.28	$3.19
4 Inch line	105.44	8.97	156.12	13.01
6 Inch line	239.63	19.97	347.52	28.96
8 Inch line	426.55	35.55	618.60	51.55
10 Inch line	666.18	55.52	966.00	80.50
12 Inch line	958.54	79.88	1,389.96	115.83

Temporary Users

Water furnished to temporary users, such as contractors, etc. shall be charged on the basis of the metered rates as metered or estimated by the utility manager.

(The Accountants Compilation Report and accompanying comments are an integral part of this statement.)

ELKHART MUNICIPAL WATER UTILITY

UNAUDITED SUPPLEMENTAL FINANCIAL DATA

ELKHART (INDIANA) MUNICIPAL WATER UTILITY

COMPARATIVE STATEMENT OF NET ASSETS
(Unaudited)

	As of 12/31/05	As of 08/31/06
ASSETS:		
Current Assets:		
Operation and maintenance fund	$869,335	$1,039,587
Interest receivable	6,198	6,198
Accounts receivable	569,175	539,124
Allowance for doubtful accounts	(150,208)	(150,208)
Other accounts receivable (net)	64,863	64,863
Materials and supplies inventory	161,195	161,195
Prepaid expense	406	100,406
Total Current Assets	1,520,964	1,761,165
Non-Current Assets:		
Restricted cash:		
Depreciation fund	1,321,408	1,510,703
Tank maintenance fund	1,329,881	1,431,801
Customer deposits fund	156,863	159,953
Bond and interest account	888,379	1,034,779
Debt service reserve account	472,501	472,501
Water main extension fund		3,894
Total Non-Current Assets	4,169,032	4,613,631
Deferred Debits:		
Unamortized bond issuance costs	31,884	25,811
Unamortized bond discount	22,050	17,850
Total Deferred Debits	53,934	43,661
Capital Assets:		
Utility plant in service	43,215,659	43,433,845
Construction in progress	2,853,280	2,853,280
Sub-totals	46,068,939	46,287,125
Accumulated depreciation	(11,054,697)	(11,421,364)
Total Net Capital Assets	35,014,242	34,865,761
Total Assets	$40,758,172	$41,284,218

(Continued on next page)

(The Accountants' disclaimer of opinion
is an integral part of this statement)

ELKHART (INDIANA) MUNICIPAL WATER UTILITY

(Cont'd)

COMPARATIVE STATEMENT OF NET ASSETS
(Unaudited)

	As of	
	12/31/05	08/31/06
LIABILITIES:		
Current Liabilities:		
Accounts payable	$61,130	$83,841
Wages and benefits payable	48,123	54,705
Sales tax payable	(70,271)	85,668
Due to other funds	26,310	26,540
Compensated absences (current)	13,263	
Deposits payable	65,137	65,137
Hydrant deposits payable		6,500
Other taxes payable	91,525	70,271
Current portion of long term debt	805,000	815,000
Matured interest payable	6,817	6,817
Total Current Liabilities	1,047,034	1,214,479
Noncurrent Liabilities:		
Bonds payable	1,995,000	1,585,000
Compensated absences payable	68,356	
Total Noncurrent Liabilities	2,063,356	1,585,000
Total Liabilities	$3,110,390	$2,799,479
NET ASSETS:		
Invested in capital assets, net of related debt	$29,360,962	$29,612,481
Restricted for debt service	1,360,880	1,507,280
Restricted for capital outlay		3,894
Unrestricted net assets	6,925,940	7,361,084
Total Net Assets	$37,647,782	$38,484,739

(The Accountants' disclaimer of opinion
is an integral part of this statement)

ELKHART (INDIANA) MUNICIPAL WATER UTILITY

COMPARATIVE STATEMENT OF REVENUES, EXPENSES AND OTHER CHANGES IN FUND NET ASSETS
(Unaudited)

	Calendar Year 2005	12 Months Ended 08/31/06
Operating Revenues:		
Metered revenues	$5,215,995	$5,181,483
Fire protection	392,890	414,001
Other	677,331	504,062
Total operating revenues	6,286,216	6,099,546
Operating Expenses:		
Lab and pretreatment	150,072	103,619
Water treatment	1,049,984	1,147,113
Transmission and distribution	620,299	684,927
Customer accounts	286,397	313,079
Administrative and general	1,812,143	1,741,782
Sub-totals	3,918,895	3,990,520
Depreciation expense	717,765	717,765
Total operating expenses	4,636,660	4,708,285
Net operating revenues	1,649,556	1,391,261
Other Income:		
Interest income	49,974	56,000
Other Expenses:		
Interest expense	101,700	89,925
Amortization expense	16,488	16,488
Totals	118,188	106,413
Change in Net Assets	1,581,342	1,340,848
Net Assets - Beginning	36,066,440	37,143,891
Net Assets - Ending	$37,647,782	$38,484,739

(The Accountants' disclaimer of opinion is an integral part of this statement)

ELKHART (INDIANA) MUNICIPAL WATER UTILITY

COMPARATIVE SCHEDULE OF DETAILED OPERATING EXPENSES
(Unaudited)

	Calendar Year 2005	12 Months Ended 08/31/06
Lab and Pretreatment		
Salaries and wages	$89,440	$46,027
Employee benefits	14,502	9,193
Materials and supplies	14,405	10,951
Transportation	50	50
Contractual services	3,787	3,796
Testing	26,591	32,135
Rent	952	952
Miscellaneous	345	515
Sub-totals	150,072	103,619
Water Treatment		
Salaries and wages	404,274	473,158
Employee benefits	77,381	80,584
Purchased power	281,789	259,635
Natural gas	47,373	52,789
Materials and supplies	60,418	62,086
Chemicals	51,636	68,526
Contractual services	120,427	144,000
Miscellaneous	6,686	6,335
Sub-totals	1,049,984	1,147,113
Transmission and Distribution		
Salaries and wages	308,774	293,103
Employee benefits	98,162	100,864
Purchased power	341	7,239
Materials and supplies	141,609	204,916
Contractual services	64,900	75,126
Transportation	542	538
Miscellaneous	5,971	3,141
Sub-totals	620,299	684,927

(Continued on next page)

(The Accountants' disclaimer of opinion is an integral part of this statement)

ELKHART (INDIANA) MUNICIPAL WATER UTILITY

(Cont'd)

COMPARATIVE SCHEDULE OF DETAILED OPERATING EXPENSES

(Unaudited)

	Calendar Year 2005	12 Months Ended 08/31/06
Customer Accounts		
Salaries and wages	$93,236	$115,413
Employee benefits	29,616	29,330
Materials and supplies	145,630	149,506
Contractual services	17,686	18,383
Transportation	183	278
Miscellaneous	46	169
Sub-totals	286,397	313,079
Administrative and General		
Salaries and wages	263,431	320,276
Employee benefits	79,504	75,801
Materials and supplies	11,559	12,041
Utilities	328	278
Contractual services	280,315	213,395
Rent	1,294	928
Transportation	183	138
Payments in lieu of tax	550,000	550,005
Insurance	120,000	130,000
Sales tax	241,879	238,572
Gross income taxes	90,340	59,287
Miscellaneous	173,310	141,061
Sub-totals	1,812,143	1,741,782
Totals	$3,918,895	$3,990,520

(The Accountants' disclaimer of opinion
is an integral part of this statement)

ELKHART (INDIANA) MUNICIPAL WATER UTILITY

COMPARATIVE STATEMENT OF CASH FLOWS
Increase (Decrease) in cash and cash equivalents
(Unaudited)

	Calendar Year 2005	12 Months Ended 08/31/06
Cash flows from Operating Activities		
Cash received from customers	$6,283,814	$5,965,533
Cash paid to suppliers, employees and others	(4,081,363)	(4,138,829)
Net Cash from Operating Activities	2,202,451	1,826,704
Cash Flows from Capital and Related Financing Activities:		
Additions to utility plant	(1,173,679)	(1,121,477)
Principal paid on bonds	(785,000)	(795,000)
Interest payments	(101,700)	(89,925)
Net Cash from Capital Financing Activities	(2,060,379)	(2,006,402)
Cash Flows from Investing Activities		
Interest income	45,574	51,600
Cash and Cash Equivalents:		
Increase (Decrease)	187,646	(128,098)
Beginning Balance	4,850,721	5,781,316
Ending Balance	$5,038,367	$5,653,218

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(The Accountants' disclaimer of opinion
is an integral part of this statement)

ELKHART (INDIANA) MUNICIPAL WATER UTILITY

(Cont'd)

COMPARATIVE STATEMENT OF CASH FLOWS
Increase (Decrease) in cash and cash equivalents
(Unaudited)

	Calendar Year 2005	12 Months Ended 08/31/06
Reconciliation of net income to cash provided from operations:		
Net Operating Revenues	$1,649,556	$1,391,261
Adjustments to reconcile net income to net cash provided from operating activities:		
Depreciation Expense	717,765	717,765
Change in assets and liabilities:		
Decrease (Increase) in		
Accounts receivable	7,852	(123,759)
Other accounts receivable	(10,254)	(10,254)
Increase (Decrease) in		
Due from other funds	114,212	114,212
Materials and supplies	(10,731)	(10,731)
Prepaid expense	(203)	(50,203)
Accounts payable	(70,902)	(112,224)
Wages and Benefits payable	(60,121)	7,589
Sales tax payable	(70,271)	(75,305)
Due to other funds	(64,688)	(64,458)
Compensated absences (current)	(9,534)	
Current portion of Suburban Utilities lease	(26,354)	(26,355)
Deposits payable	(7,605)	(7,605)
Hydrant deposits payable		6,500
Other taxes payable	21,254	70,271
Compensated absences (long-term)	22,475	
Net Cash Provided from Operations	$2,202,451	$1,826,704

(The Accountants' disclaimer of opinion
is an integral part of this statement)

ELKHART (INDIANA) MUNICIPAL WATER UTILITY

COMPARISON OF ACCOUNT BALANCES WITH MINIMUM BALANCES REQUIRED

Account:	Account Balance at 8/31/06 (Unaudited)	Minimum Balance Required (1)	Ref.	Variance
Operation and maintenance	$1,039,587	$714,422	(2)	$325,165
Bond and interest	1,034,779	147,000	(3)	887,779
Debt service reserve	472,501	472,500	(4)	1
Depreciation fund	1,510,703	856,829	(5)	653,874
Tank maintenance fund	1,431,801	1,431,801	(6)	
Water main extension fund	3,894	3,894	(6)	
Customer deposits fund	159,953	159,953	(7)	
Totals	$5,653,218	$3,786,399		$1,866,819

(1) Balances required in accordance with Bond Ordinance 4759.

(2) The balance maintained in the operation and maintenance account should be sufficient to pay the expenses of operation, repair, and maintenance of the utility for the next succeeding two (2) calendar months.

Forecasted operation and maintenance expense	$4,285,674
Times factor for 2 months	0.1667
Minimum balance required	$714,422

(Continued on next page)

(The Accountants' disclaimer of opinion is an integral part of this statement)

ELKHART (INDIANA) MUNICIPAL WATER UTILITY

(Cont'd)

COMPARISON OF ACCOUNT BALANCES WITH MINIMUM BALANCES REQUIRED

(3) A balance must be maintained equal to the sum of the monthly transfers in the amount of one-sixth (1/6) of the next succeeding principal payment and one-sixth (1/6) of the next succeeding interest payment.

2003 Bonds	Amount		Factor	Total	
Principal due 1/1/07	$405,000	x	2/6	$135,000	
Interest due 1/1/07	36,000	x	2/6	12,000	
Minimum balance required					$147,000

(4) Per Bond Ordinance No. 4759, an amount equal to 10% of the original proceeds all outstanding bonds of the utility must be maintained in this account.

(5) No minimum balance required. However, as a general rule an amount equal to one year's depreciation allowance is typically maintained in this account to provide a funding source for ongoing capital improvements, emergencies and unforeseen contingencies.

Minimum balance suggested	$856,829

(6) Restricted per utility management.

(7) Restricted for customer meter deposit returns.

(The Accountants' disclaimer of opinion is an integral part of this statement)

ELKHART (INDIANA) MUNICIPAL WATER UTILITY

SCHEDULE OF AMORTIZATION OF OUTSTANDING $2,400,000 PRINCIPAL AMOUNT OF TAXABLE WATERWORKS REFUNDING REVENUE BONDS OF 2003

Principal payable semi-annually on January 1st and July 1st.
Interest payable semi-annually on January 1st and July 1st.
Interest rates as indicated.
(Unaudited)

Payment Date	Principal Outstanding	Principal	Interest Rate(s)	Interest	Total	Bond Year Total
	(------In $1,000's------)		%	(--------------------In Dollars--------------------)		
01/01/07	$2,400	$405	3.00	$36,000.00	$441,000.00	
07/01/07	1,995	410	3.00	29,925.00	439,925.00	$880,925.00
01/01/08	1,585	420	3.00	23,775.00	443,775.00	
07/01/08	1,165	425	3.00	17,475.00	442,475.00	886,250.00
01/01/09	740	430	3.00	11,100.00	441,100.00	
07/01/09	310	310	3.00	4,650.00	314,650.00	755,750.00
Totals		$2,400		$122,925.00	$2,522,925.00	$2,522,925.00

(The Accountants' disclaimer of opinion
is an integral part of this statement)

ELKHART (INDIANA) MUNICIPAL WATER UTILITY

CALCULATION OF HISTORICAL ADDITIONS TO UTILITY PLANT AND PRO FORMA DEPRECIATION ALLOWANCE

I. Calculation of Average Annual Additions to Utility Plant Funded Through All Sources (Unaudited):

Utility plant in service at 12/31/02		$41,671,180
Calendar Year	Additions	
2003	$993,787	
2004	426,867	
2005	123,825	
As of 8/31/06	218,186	
Total additions to utility plant		1,762,665
Utility plant in service at 8/31/06 (Unaudited)		$43,433,845
Total additions to plant		$1,762,665
Divide by period covered (3 years 8 months)		3.67
Average annual additions to utility plant		$480,290

II. Calculation of Pro Forma Depreciation Allowance

Utility plant in service at 8/31/06 (unaudited)	$43,433,845
Add capitalized items	4,950
Less land (unaudited)	(597,370)
Depreciable utility plant	42,841,425
Times depreciation rate	2.0%
Pro Forma Annual Depreciation Allowance	$856,829

(The Accountants' disclaimer of opinion is an integral part of this statement)

Petitioner's Exhibit SAM-3

Proposed No. 06-O-37R

ORDINANCE NO. 4978

AN ORDINANCE ESTABLISHING RATES AND CHARGES FOR THE USE OF AND SERVICES RENDERED BY THE WATER WORKS SYSTEM OF THE CITY OF ELKHART, INDIANA

WHEREAS, the City of Elkhart, Indiana, (the "City") owns, operates and maintains a water works system (the "Water Works") for the benefit of the citizens of Elkhart; and

WHEREAS, the Board of Public Works (the "Board") of the City, governing body of the Water Works, has reviewed the financial requirements of the Water Works and determined that the current rates and charges of the Water Works adopted on February 1, 1994, are insufficient to fund ongoing and future operating and maintenance expenses, equipment expenses, bond and interest expenses, payments in lieu of taxes, and capital improvement expenses; and

WHEREAS, the Board adopted Resolution No. 06-09 on July 5, 2006, recommending to the Common Council of the City that the Common Council authorize and approve an increase in the rates and charges of the Water Works to generate sufficient additional revenues to fund ongoing and future expenditures of the Water Works; and

WHEREAS, any new rates and charges should be sufficient to ensure that the City receives a reasonable return on the water utility plant of the City and that the City is compensated for the taxes that would be due the City on the utility property if it were privately owned; and

WHEREAS, the Common Council has considered all relevant information pertaining to this matter and now finds that the existing rates and charges for the use of and services rendered by the Water Works are too low and are insufficient to enable the City to properly operate its water works plant, provide for depreciation, service outstanding obligations, finance new construction, improvements, extensions and additions, and cover the costs identified in IC 8-1.5-3-8; and that the existing rates and charges should be increased.

NOW, THEREFORE, BE IT ORDAINED BY THE COMMON COUNCIL OF THE CITY OF ELKHART, INDIANA, AS FOLLOWS:

Section 1. The recurring rates and charges set out in Appendix A, attached hereto and made a part hereof, and non-recurring charges set out in Appendix B, attached hereto and made a part hereof are hereby adopted and established as the rates and charges for the use of and the services rendered by the Water Works System of the City of Elkhart, Indiana.

Section 2. All ordinances and parts of ordinances in conflict with this Ordinance are repealed upon this Ordinance becoming effective as set forth herein.

Section 3. This Ordinance shall be in effect from and after its passage by the Common Council, approval by the Mayor, approval by the Indiana Utility Regulatory Commission and legal publication.

PASSED, ADOPTED, AND ORDAINED by the Common Council of the CITY OF ELKHART on this 7th day of August, 2006.

Brian A. Thomas
Brian A. Thomas
President of the Common Council

ATTEST:

Sue M. Beadle
Sue M. Beadle, City Clerk

PRESENTED by me to the Mayor of the CITY OF ELKHART on the 10th day of August, 2006.

Sue M. Beadle, City Clerk

THIS ORDINANCE approved and signed by me on the 14 day of August, 2006.

David L. Miller, Mayor

ATTEST:

Sue M. Beadle, City Clerk

APPENDIX A

ELKHART MUNICIPAL WATER UTILITY
Elkhart, Indiana

Schedule of Rates and Charges

(A) **Monthly Metered Rates:**

Available to all Commercial and Industrial accounts with one inch or larger meter. For use of and service rendered by the Elkhart Municipal Water Utility (Utility) based on the use of water supplied by said Utility.

Block Schedule	Rates per 100 CF
First 4,000 Cubic Feet	$ 1.51
Next 74,000 Cubic Feet	1.16
Next 68,000 Cubic Feet	.93
Over 146,000 Cubic Feet	.78

(B) **Bi-Monthly Metered Rates:**

Available to all other accounts. All customers' meters will be read bi-monthly; however, accounts will be billed monthly. During the bi-monthly period, the first month bill will be based on minimum charges and the second month bill will be adjusted for actual usage.

Block Schedule	Rates per 100 CF
First 8,000 Cubic Feet	$ 1.51
Next 148,000 Cubic Feet	1.16
Next 136,000 Cubic Feet	.93
Over 292,000 Cubic Feet	.78

(C) **Service Charge:**

Each user is subject to the following service charge per month, which is included within the minimum or is added to the volume charge in excess of a minimum user.

Meter Size	Monthly Rates
5/8 inch	$ 2.32
3/4 inch	2.54
1 inch	3.12
1 1/2 inch	4.74
2 inch	7.00
3 inch	13.50
4 inch	22.61
6 inch	48.59

8 inch	84.96

(D) Minimum Charge:

Each user shall pay a minimum charge according to the following meter size for which the user will be entitled to the quantity of water shown for each month.

Meter Size	Water Allowance CCF	Monthly Charge
5/8 inch	4	$ 8.36
3/4 inch	6	11.60
1 inch	10	18.22
1 1/2 inch	20	34.94
2 inch	32	55.32
3 inch	60	97.10
4 inch	100	152.61
6 inch	200	294.59
8 inch	320	470.16

(E) Public Fire Protection:

Each user is subject to the following public fire protection charge per month.

Meter Size	Monthly Public Fire Hydrant Charges
5/8"	$ 2.84
3/4"	3.12
1"	3.97
1 1/4"	4.54
1 1/2"	5.12
2"	8.24
3"	31.23
4"	39.76
6"	59.64
8"	82.35

(F) Private Fire Protection Service:
(Automatic Sprinkler System)

Size	Annual Charge	Monthly Charge
2 inch line	$ 38.22	$ 3.19
4 inch line	152.89	12.75
6 inch line	347.46	28.96
8 inch line	618.50	51.55

10 inch line	965.96	80.50
12 inch line	1,389.88	115.83

(G) Temporary Users:

Water furnished to temporary users, such as contractors, etc. shall be charged on the basis of the metered rates as metered or estimated by the utility manager.

(H) Delinquent Charge:

All billings not paid within 17 days of the billing date are subject to a late payment charge of 10% on the first $3.00 and 3% of the balance over $3.00.

Non-Recurring Charges

Current rates effective ___________________.

Pursuant to Cause No. ________, approved ___________.

Appendix B

Analytical Services	
Bacteriological analysis	$25.00
Visit to collect past due accounts	$24.00
Visit to establish new account	$24.00
Meter testing (5 / 8" – 1")	$48.00
Install new meter	
Labor per hour, minimum 1 hour	$24.00
5 / 8"	$86.66
3 / 4"	$120.00
1"	$157.92
1-1/2"	$340.38
2"	$456.77
New customer deposit (water and sewer)	$80.00
Insufficient check charge	$27.50
Meter Settings (vendors cost plus 20%)	
Meter Yokes 5 / 8" Meter	$33.60
1" Meter	$57.60
Loc Packs 1 ½" for copper	$45.73
1 ½" for galvanized	$47.10
2" for copper	$56.10
2" for galvanized	$60.94
Visit to reconnect service (turned off for cause)	$48.00
After hours service call	$104.00
Relocation of AMR device	$24.00
Street key rental (deposit)	$50.00
Replacement cost of frozen meters (vendors cost plus 20%)	
Labor per hour, minimum 1 hour	$24.00
5 / 8"	$86.66
3 / 4"	$120.00
1"	$157.92
1 1/2"	$340.38
2"	$456.77

"Appendix B continued"

Special Meter Reading (at customers convenience)	$24.00
Sprinkling meter turn-on or turn-off	$24.00
Meter Deposits for temporary service (water is paid for separately)	
5 / 8"	$54.00
1"	$120.00
Fill swimming pool	$120.00
Contractor rate for temporary water	
Residential	Policy Rule
Commercial	Policy Rule
Demolition Permit	Policy Rule
Fire hydrant use	Policy Rule
Fire hydrant inspection fee	Policy Rule
Temporary Meter deposit	Policy Rule
Service line repairs	Policy Rule
Tap inspection	Policy Rule

Petitioner's Exhibit EH

CITY OF ELKHART, INDIANA

IURC CAUSE NO. 43191

VERIFIED DIRECT TESTIMONY

OF

ERIC HORVATH

SPONSORING

PETITIONER'S EXHIBITS EH-1 and 2

Petitioner's Exhibit EH

VERIFIED DIRECT TESTIMONY
OF
ERIC HORVATH
CAUSE NO. 43191

BACKGROUND

Q. Please state your name.

A. Eric Horvath.

Q. What is your relationship with Petitioner City of Elkhart ("Petitioner" or the "City")?

A. Presently, I have no relationship with the City. However, from 1993 through June of 2006, I worked in various capacities for the City of Elkhart. Most recently, from January 2000 to June 2006, I was the Public Works & Utilities Director for the City of Elkhart. In that role, I was responsible for the overall operations of the Municipal Water Utility.

Q. What is your educational and professional background?

Attached hereto as Petitioner's Exhibit EH-1 is a current copy of my resume.

Q. What is the purpose of your testimony?

A. I will sponsor and explain Petitioner's 4-year capital improvement plan.

Q. Please describe the Elkhart Water Utility.

A. The Elkhart Municipal Water Utility is a system made up of three ground water sources, four elevated storage tanks and a distribution network serving an area of approximately 47 square miles within and around the corporate limits of Elkhart. A further and more detailed description of the water utility is contained in the Master Plan for Water Supply and Distribution 2001-2015 which is included in the exhibits which I am sponsoring.

Q. Please identify Petitioner's Exhibit EH-2.

A. Petitioner's Exhibit EH-2 sets forth Petitioner's four year Water Utility Capital Improvement Plan. The first page is a summary tabulation followed by several pages each of which provides an explanation for the projects in the Capital Improvement Plan and the cost estimate. Also included within this exhibit is an attachment consisting of Petitioner's Master Plan that I have previously referenced. Finally, there are a number of Appendices which provide further support and information related to the projects.

Q. Can you briefly summarize the types of projects that are included in the capital improvement plan?

A. Yes. There are two elevated storage tanks. These are both identified in the Master Plan. These are needed for fire protection but also to meet the peak hour demand on the peak day.

There are a number of projects which involve the replacement of aging distribution mains that are being coordinated with an ongoing storm sewer separation project. In other words, while the streets are being disturbed for the storm sewer work, it makes sense to proceed and replace these aged water mains at the same time. These distribution system replacement projects are not part of the Master Plan, but they need to be completed and it is better to do so while the streets are being excavated.

Third, there is a rehabilitation to the North Main Pumping Station. The explanation of the need for this project is set forth in the memorandum attached as Appendix A to the Exhibit.

Finally, there are a number of distribution system improvements intended to loop the system so as to improve pressure and flow. These projects are all identified in the Master Plan.

Q. With respect to the North Main Pump Station rehabilitation, is Petitioner proposing to follow the recommendation set forth in the memorandum attached as Appendix A to the Exhibit?

A. Not entirely. The engineering firm proposed a number of alternatives to address the needs at this pumping station. Of all the alternatives, they recommended complete replacement of the pumping station. We have chosen Alternative Four instead, which includes replacement of all the valves and piping in the lower level of the pumping station. We have made this choice for a number of reasons, including the desire to save cost. In addition, our reliance on the North Main Street Wellfield has been diminishing in recent years due to the location of development in and around Elkhart. Petitioner simply felt it more prudent to spend less money on this asset than the engineers had recommended.

Q. Please identify where the Ash Road 16" River Crossing -- US 20 to CR 16 is set forth in the Master Plan.

A. If you turn to Figure 7.2.1 of the Master Plan, this is 16" in County Line (Ash) Rd from CR 16 to US 20, which is the 7th item shown in Blue (Phase II).

Q. Where is the 24" Water Main - CR 13 Loop set forth in the Master Plan?

A. This is an item slated for Fiscal Year 2009 in the Capital Improvement Plan. It is the second item set forth on Figure 7.2.1 of the Master Plan.

Q. With respect to the four 24" main projects that are all facets of the same larger project (the last two items for Fiscal Year 2009 and the last two items for Fiscal Year 2010 of the Capital Improvement Plan), can you identify these in the Master Plan?

A. Yes. Again using Figure 7.2.1, these are part of the first four items shown for Phase II. The portion of this main from Franklin to Pennsylvania has already been completed.

Q. The Master Plan also recommended improvements to the Northwest Well field and the South Wellfield to expand capacity. What is the status of these projects?

A. The South Wellfield expansion has been completed. The capacity of the Northwest Wellfield has been expanded, but we have not yet expanded the capacity of the treatment plant. These projects are not part of our current Capital Improvement Plan.

Q. Another project identified in the master plan is the 24-inch loop closure on County Road 6 (Christiana Creek). What is the status of that project?

A. That project also has previously been completed.

Q. The master plan also identifies a 24-inch main in Bristol Street to be completed about the same time period as that covered by Petitioner's current water utility capital improvement plan. What is the status of that project?

A. This is still on the list of projects to be completed but has been post-poned for two reasons. First, it is not as high a priority as the projects included in the current Capital Improvement Plan. Second, this work will be more cost effective if it is done in conjunction with the County's widening of Bristol Street which his currently scheduled to take place in the next 5-7 years.

Q. Are all of the projects contained in the Capital Improvement Plan reasonably necessary for the provision of adequate utility service by Petitioner?

A. Yes. A great deal of planning has gone into identifying and prioritizing these projects. The Master Plan and other Appendices to the exhibit fully explain the need for these projects and why they are important to the provision of adequate utility service.

Q. Are the cost estimates reasonable for these projects?

A. Yes. These cost estimates are based upon Petitioner's experience and engineering estimates. In my experience, I find them to be reasonable.

Q. Does this conclude your prepared direct testimony?

A. Yes, at this time.

AFFIRMATION

I affirm under the penalties for perjury that the foregoing testimony is true to the best of my knowledge, information, and belief.

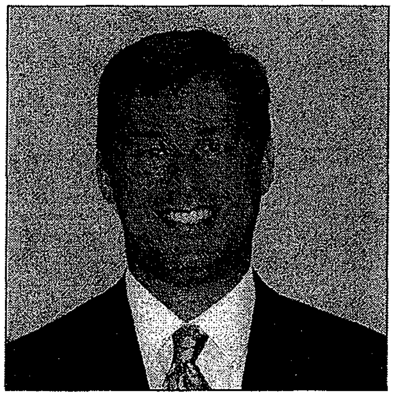
Signed: ______________________________

Printed: ____Eric Horvath____________________

INDS01 NKK 919349v1

ERIC C. HORVATH, PE

PROJECT EXPERIENCE



REGISTRATION:

Professional Engineer in Indiana

EDUCATION:

Master of Science in Administration, 2001, University of Notre Dame, South Bend, Indiana
Bachelor of Science, Civil Engineering and Bachelor of Arts, Psychology, 1993, University of Notre Dame, South Bend, Indiana

PROFESSIONAL SOCIETIES:

American Society of Civil Engineers
American Water Works Association
Water Environment Federation
Indiana Water Environment Association

RESPONSIBILITIES:

Mr. Horvath is responsible for managing the administration and operations of the northern regional office of American Consulting. Mr. Horvath has extensive experience in water, sewer, transportation, and environmental engineering, as well as financial management and budgetary control. His responsibilities include new business development and building and leading a regional production staff.

City of Elkhart, Public Works Director, City Engineer

Directed the Public Works Department of the City of Elkhart with a staff of 150 employees and an annual operating and capital budget of over 34 million dollars. Accountable for the finances and administration of the Elkhart Municipal Airport, Water Utility, Wastewater Utility, and all City Environmental and Transportation Engineering.

Directed the operation and maintenance of the City Wastewater Utility, including 270 miles of sewer mains, 50 lift stations and a 30 million GPD wastewater treatment plant that received an award from the United States Environmental Protection Agency for being the best advanced treatment plant in a six-state area.

Directed, supervised, and participated in the planning, design, specification writing, bidding, construction, quality control, and inspection of all capital improvement projects, including building renovations, environmental remediations, urban beautifications, and large, complex sewer, water, and transportation infrastructure projects. Monitored construction and operation costs and implemented procedures to reduce budget and improve overall performance.

Worked with businesses and developers on water, sewer, and transportation infrastructure to encourage smart economic growth and development and enhance the local tax base. Recommended public policy and strategy and implemented resultant projects and programs.

Directed and administered the long-range capital improvement plans, including 25-year Transportation Improvement Plan, Water Master Plan, Wellhead Protection Plan, MS4 Stormwater Plan, Wastewater Comprehensive Facility Plan, and the Long-Term Control Plan for CSO abatement.

Managed and operated the City Water Utility responsible for delivering over ten million gallons of clean, safe drinking water each day to over 60,000 customers. Responsible for the operation and maintenance of three wellfields and 320 miles of water mains.

Ensured permit compliance and process control for safe drinking water and federally mandated pretreatment programs. Administered environmental regulatory affairs for the City as they relate to air, land, and water quality issues.

PETITIONER'S EXHIBIT
EH-1

PETITIONER'S EXHIBIT EH-2

City of Elkhart, Indiana

Water Utility Capital Improvement Plan

Fiscal Years 2007-2010

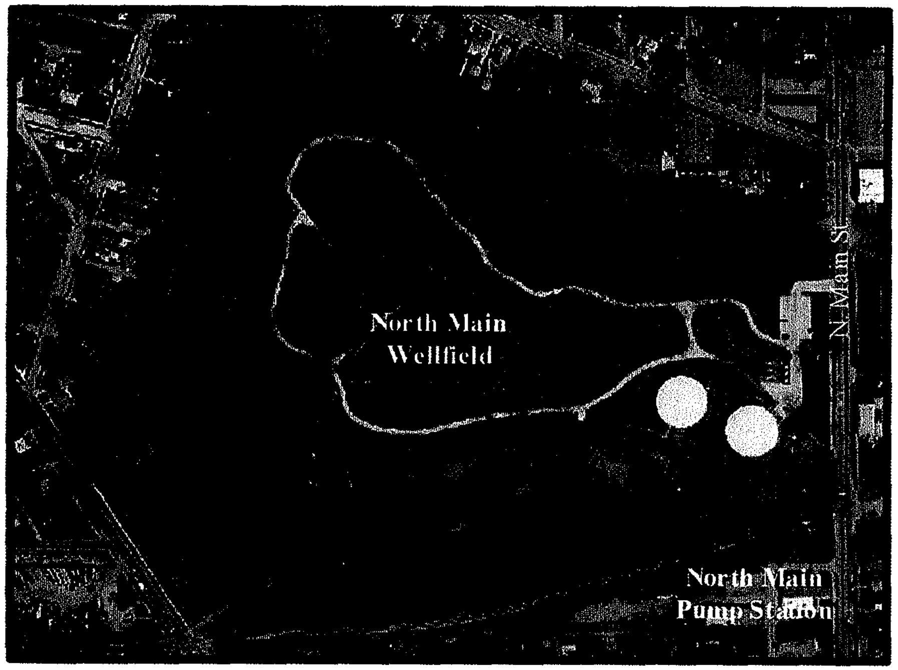
	2006 Estimated Water Utility Cost	Basis of Cost Estimation
Fiscal Year 2007		
North Main Pump Station Rehabilitation	$1,300,000	N. Main St. Pumping Station Evaluation Technical Memo - Appendix A
Northeast Elevated Storage Tank (1MG) - Design	$172,650	2001-2015 Master Plan - % of Construction Cost - Attachment A
Supervisory Control and Data Acquisition Upgrades	$20,000	Vendor Quote - Appendix B
Ash Road 16" River Crossing - US 20 to CR 16	$679,090	2001-2015 Master Plan - Attachment A
Hubbard Ave. Revitalization - Water Main Replacement	$315,000	City of Elkhart Construction Cost Data - Appendix C
Hudson St. - Water Main Replacement	$445,000	City of Elkhart Construction Cost Data - Appendix C
Fiscal Year 2008		
Northeast Elevated Storage Tank (1MG) - Land Acq.	$40,000	Local Developer Estimate - Appendix D
Southeast Elevated Storage Tank (.75 MG) - Design	$172,650	2001-2015 Master Plan - % of Construction Cost - Attachement A
Beardsley Ave. Revitalization - Water Main Replacement	$360,000	City of Elkhart Construction Cost Data - Appendix C
Crawford St. Revitalization - Water Main Replacement	$330,000	City of Elkhart Construction Cost Data - Appendix C
Johnson St. Widening - New 20" Water Main	$510,000	City of Elkhart Construction Cost Data - Appendix C
Fiscal Year 2009		
Northeast Elevated Storage Tank (1MG)	$2,129,350	2001-2015 Master Plan - Attachment A
Southeast Elevated Storage Tank (.75MG) - Land Acq.	$40,000	Local Developer Estimate - Appendix D
Kilbourn St. Revitalization - Water Main Replacement	$435,000	City of Elkhart Construction Cost Data - Appendix C
Fulton St. Revitalization - Water Main Replacement	$640,000	City of Elkhart Construction Cost Data - Appendix C
24" Water Main - CR 13 Loop	$1,726,500	2001-2015 Master Plan - Attachment A
24" River Crossing @ Okema & Edgewater	$345,300	2001-2015 Master Plan - Attachment A
24" Water Main - Rainbow Bend & Dorsey	$471,910	2001-2015 Master Plan - Attachment A
Fiscal Year 2010		
Southeast Elevated Storage Tank (.75MG)	$1,553,850	2001-2015 Master Plan - Attachment A
S. Michigan St. - Water Main Replacement	$415,000	City of Elkhart Construction Cost Data - Appendix C
24" Water Main - SR 19 from Lusher to Franklin	$354,075	2001-2015 Master Plan - 1,500 LF Remaining - Attachment A
24" Water Main - Pennsylvania & Okema	$805,700	2001-2015 Master Plan - Attachment A
Total	**$13,261,075**	

North Main Pump Station Rehabilitation - 2007

Project Description

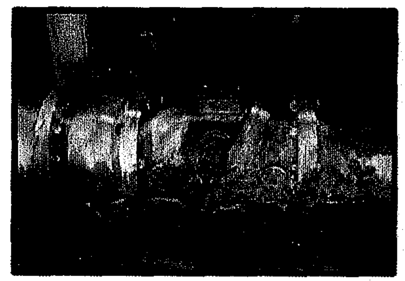
The North Main Street Wellfield is Elkhart's primary source of drinking water, supplying Elkhart with approximately 60% of its total consumption. The Pump Station has a firm capacity of 15.5 MGD, with the largest unit out of service. The Station was built in the early 1920's and contains a lower level that houses piping and valves to and from the high service pumps. This project would include a comprehensive valve and pipe replacement in the lower level of the Station. It would also include the removal of the existing floor and the construction of a new floor at a lower elevation with positive drainage to a sump pit.

Project Location



Project Need

Most of the isolation valves are double disk gate valves maunufactured by "Eddy Valves", and they date back to when the station was built. The lower level is a confined space and is difficult to access, therefore, these valves have not been exercised or maintained through the years. The valves have hydraulic actuators that are no longer operational. In addtion, the pipes in this lower level are in poor condition. In many areas, a concrete floor is poured right up against the pipes. Standing water on the floor leads to moist conditions, which have further corroded and deteriorated the pipes and valves.

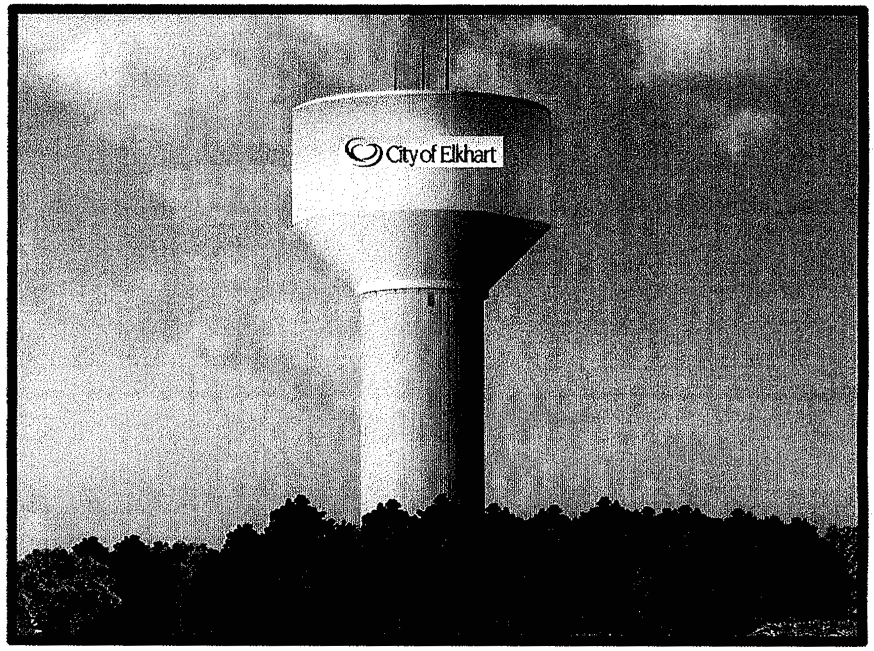


Project Benefits

The valve and pipe replacement would provide greater reliability, enhanced safety, and improved operational flexibility in the system. Sixty percent of Elkhart relies on this critical infrastructure to meet their drinking water needs.

Estimated Cost = $1,300,000

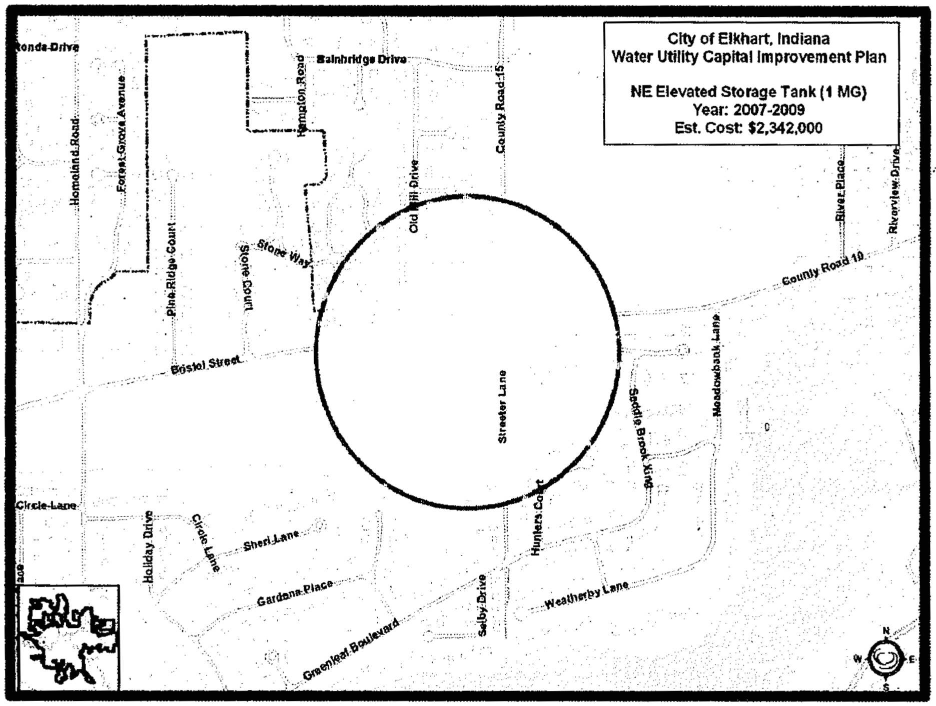
Northeast Elevated Storage Tank - 2007-2009



Project Description

A new elevated storage tank in northeast Elkhart is required to meet industry standards for equalization storage. A 1.0 MG storage tank will be constructed in northeast Elkhart. This tank will provide additional capacity for growth and development in that area and will boost pressures during peak demand hours. The tank would be primarily replenished by the Northwest Wellfield and would provide equalization storage for the northeast region of the distribution system.

Project Location



Project Need

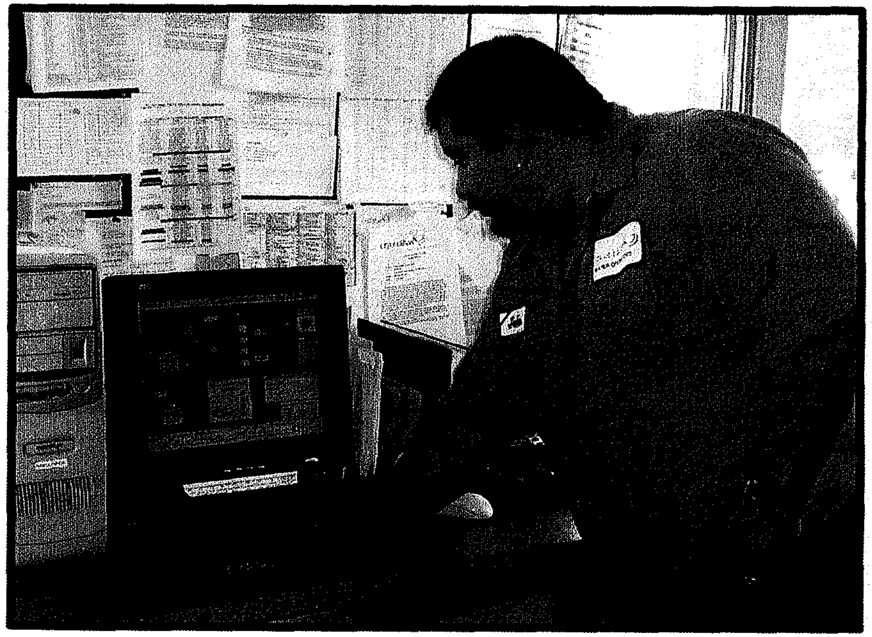
Elkhart's diurnal demand requires equalization storage for a maximum day event or 3.3 MG with a reserve of .3 MG. Elkhart's current storage is 2.5 MG, therefore, the system is currently 1.1 MG deficient in equalization storage.

Project Benefits

The Northeast Elevated Storage Tank will help maintain optimal water pressure, provide ample fire protection storage, ensure continuous water supply during peak demands, create additional capacity to promote business development, and provide emergency reserves in the event of mechanical failure at a pump station.

Estimated Cost = $2,342,000

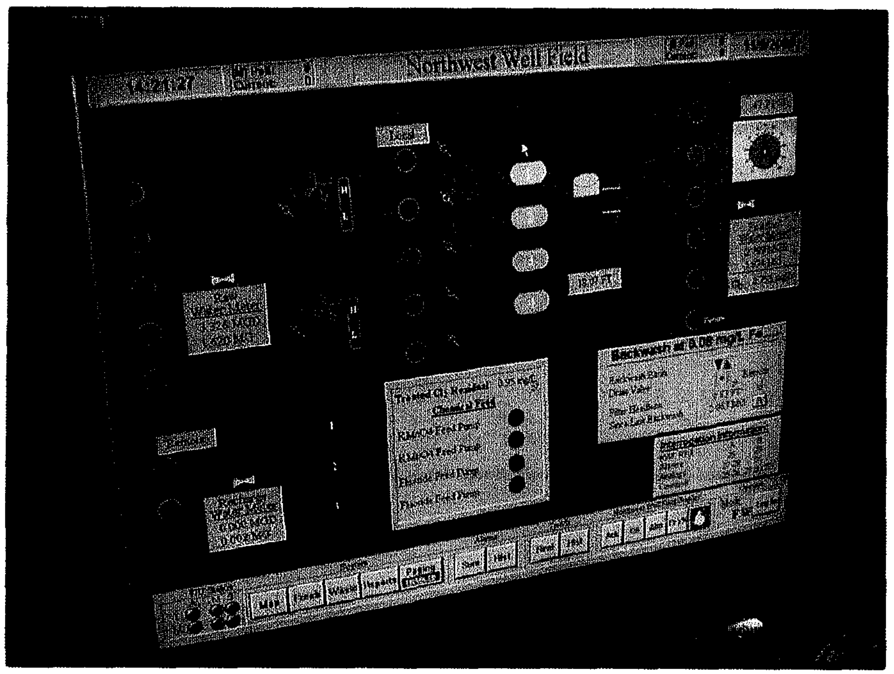
Supervisory Control & Data Acquisition Upgrade - 2007



Project Description

The City of Elkhart has a Supervisory Control and Data Acquisition (SCADA) system that remotely monitors and operates all three wellfields from one central location. This program allows operators to remotely monitor all critical wellfield operations, control water storage tank levels, turn pumps on and off at the pump stations, and monitor chemical concentrations. It also provides an alarm system for critical conditions, such as, low water storage levels or low system pressure.

The project would include an update of the existing SCADA software, which is nearly obsolete and will no longer be maintained by the manufacturer.



Project Need

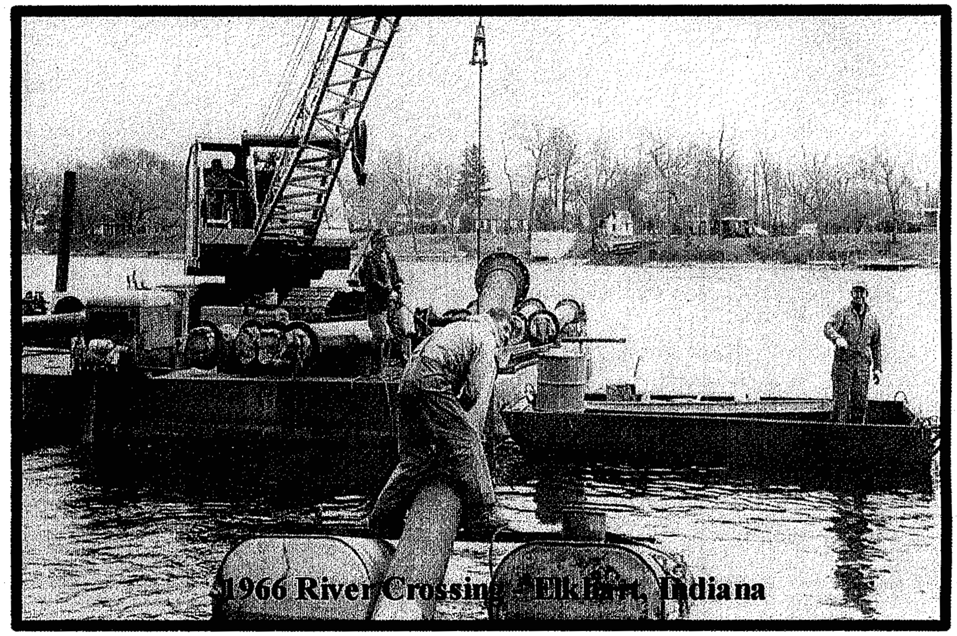
Remote telemetry units communicate information to a computer which presents process data to human operators. The software on that computer is on the verge of becoming obsolete and needs to be upgraded. The SCADA system is critical to the operations of all three wellfields, as they rely on this system to monitor and control the water system pressures, water storage levels, and chemical concentrations.

Project Benefits

It allows accurate, real-time water system monitoring with quicker control and response to critical events in the system. It reduces the overall cost of operations, as one operator can control many different systems from a central location.

Estimated Cost = $20,000

Ash Road 16″ Water Main River Crossing - 2007



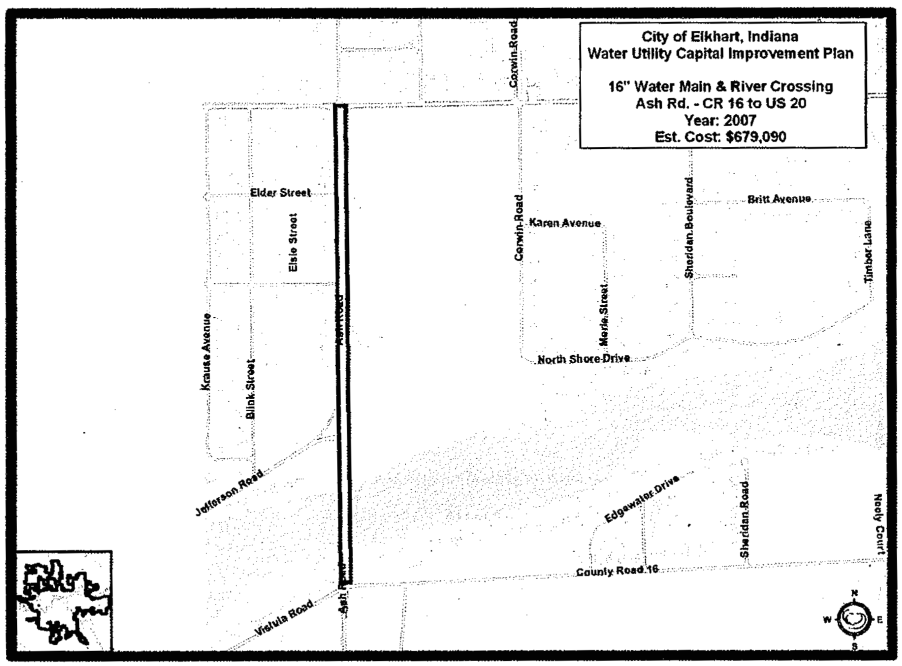
1966 River Crossing - Elkhart, Indiana

Project Description

A new 16″ water main will be installed along Ash Road from McKinley Highway to County Road 16. This project includes a crossing of the St. Joseph River, and it would serve to loop two existing water mains on the west side of Elkhart together.

The new water main would provide greater pressure and fire protection at the far west side of the distribution system, while supporting new economic development at a previously abandoned site.

Project Location



Project Need

This project is on the far west side of the distribution system with modeled pressures of 40-50 psi, given maximum day demand with fire flow. The project will also support significant economic development on the east side of Ash Road, south of McKinley Highway.

Project Benefits

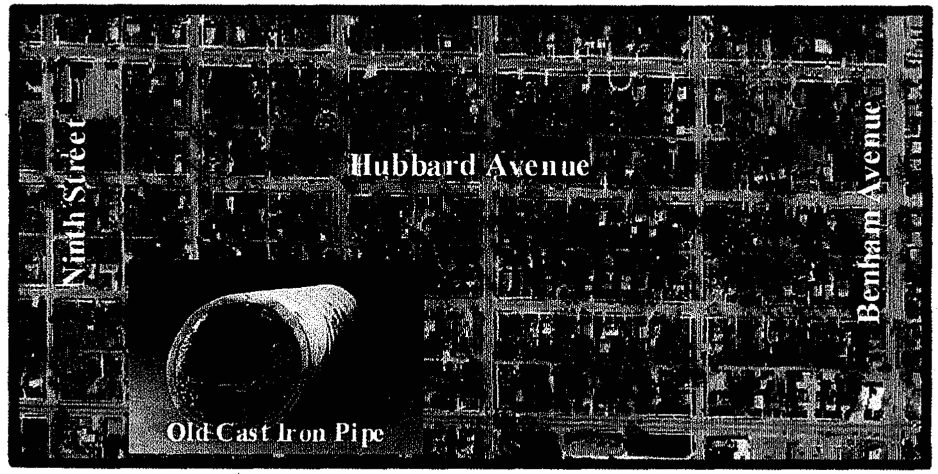
The 16″ water main and river crossing will help boost the water pressure to acceptable levels on the west side, provide better fire protection, and help meet the needs of redevelopment along Ash Road.

Estimated Cost = $679,090

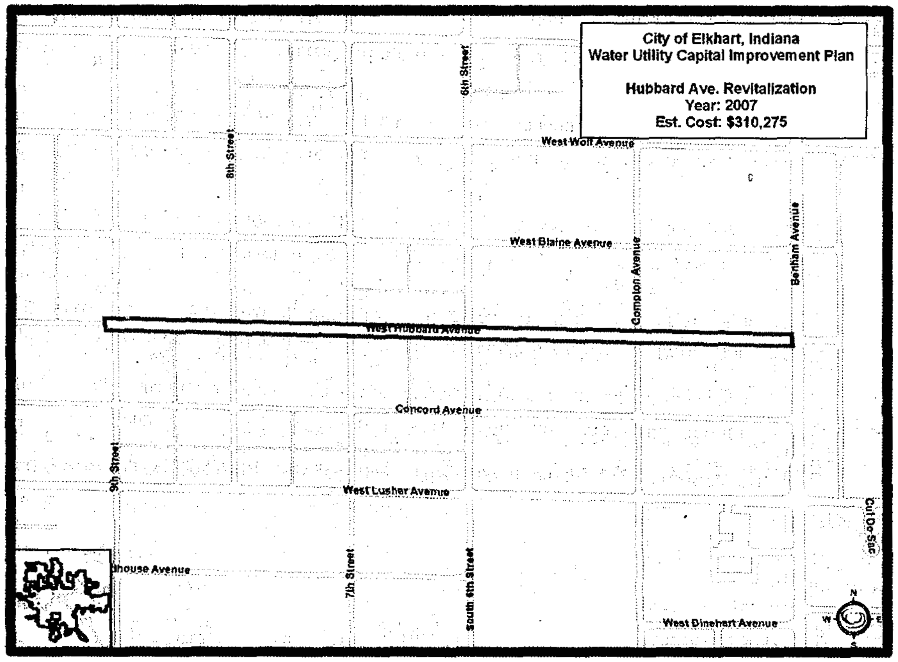
Hubbard Avenue Water Main Replacement - 2007

Project Description

This project replaces all of Elkhart's existing above ground and below ground infrastructure on Hubbard Avenue from Benham Avenue to Ninth Street, including 2,800 feet of 8″ water main. The existing water main is approaching 100 years of age and is cast iron pipe. It is very susceptible to breaking and leaking, and is a possible conduit for system contamination. Elkhart's federally mandated Combined Sewer Overflow Long Term Control Plan has obligated them to separate the combined sewer in this area. The Water Utility funds would replace the water main only, on this project.



Project Location



Project Need

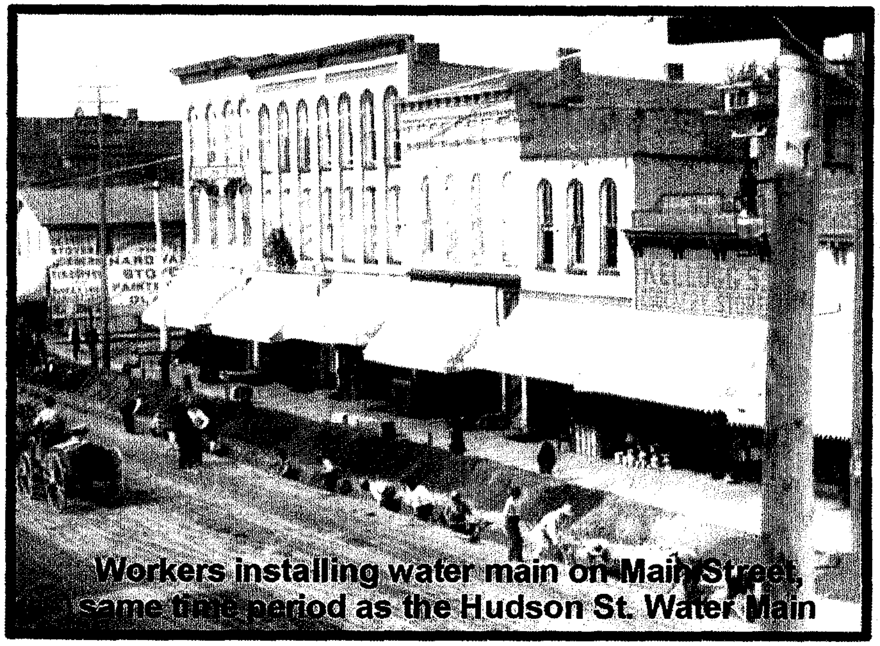
The cast iron water main is approaching 100 years old and is in need of replacement. Cast iron mains of this age are brittle and highly vulnerable to breaks. The streets on this project are already scheduled to be removed and replaced as part of the mandated Combined Sewer Overflow plan. Coordinating this project would pay for the removal and replacement of the aging water infrastructure, which is at the end of its useful life, at the same time.

Project Benefits

Coupling the water project with the planned sewer project will save over $1.3 million to the water utility. The water mains will be more reliable and the water quality will be enhanced.

Total Estimated Cost = $2,550,000
Water Utility Cost = $315,000

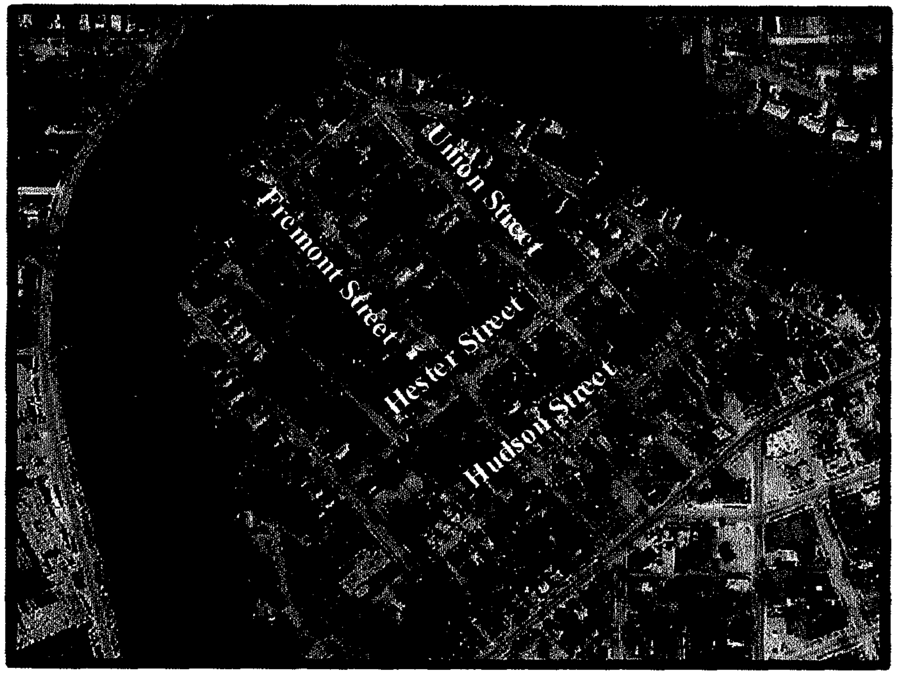
Hudson Street Water Main Replacement - 2007



Project Description

The project is on Hudson Street from Bridge Street to South Shore, on Fremont from Hudson to Hester, and on Hester from Fremont to Union Street. It would include the replacement of 4,775 feet of 8″ water main. The existing water main is approaching 100 years old and is cast iron pipe. It is very susceptible to breaking and leaking, and is a possible conduit for system contamination. This project will eliminate a combined sewer overflow by replacing all of Elkhart's existing above ground and below ground infrastructure in this area. The Water Utility funds would replace the water main only, on this project.

Project Location



Project Need

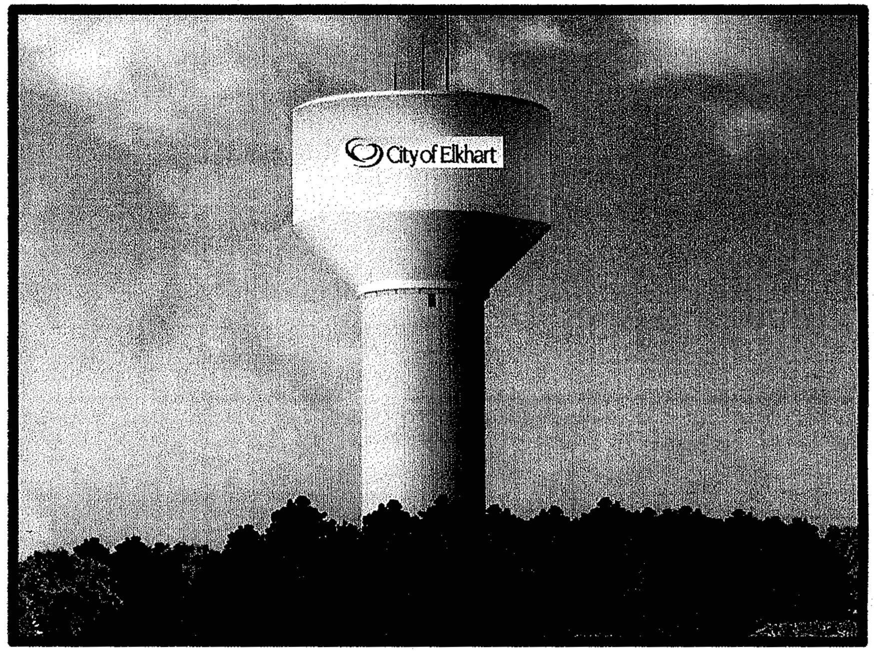
The cast iron water main is approaching 100 years old and is in need of replacement. Cast iron mains of this age are brittle and highly vulnerable to breaks. The streets in this project are already being removed and replaced as part of the mandated Combined Sewer Overflow plan. This project would pay for the removal and replacement of the aging water infrastructure, which is at the end of its useful life, at the same time.

Project Benefits

Combining the water project with the planned CSO elimination project will save over $1.1 million to the water utility. The water mains will be more reliable and the water quality in the area will be enhanced.

Total Estimated Cost = $2,085,000
Water Utility Cost = $445,000

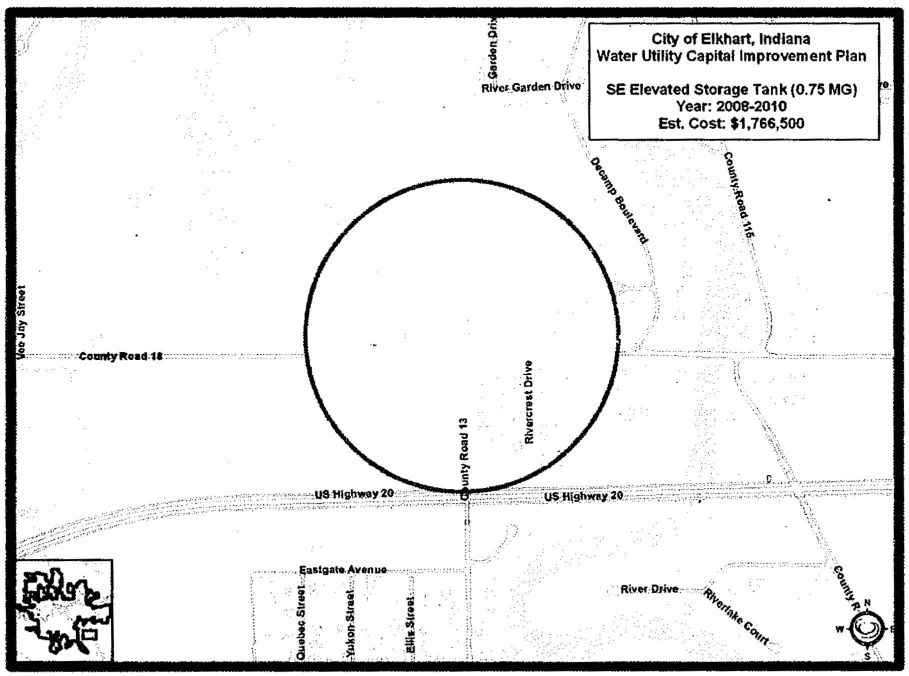
Southeast Elevated Storage Tank - 2008-2010



Project Description

A new elevated storage tank in southeast Elkhart is required to meet industry standards for system pressures. A .75 MG storage tank will be constructed in southeast Elkhart. This tank will provide additional capacity for growth and development in that area and will boost pressures during peak demand hours. The tank would be replenished primarily by the South Wellfield and would boost pressures to acceptable levels for the southeast region of the distribution system.

Project Location



Project Need

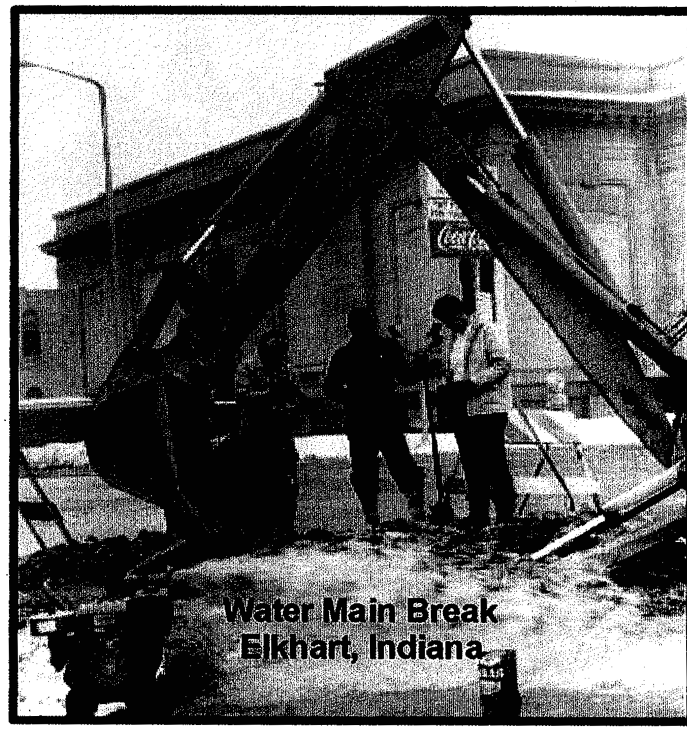
Elkhart's existing water system, modeled on a maximum demand day with fire flow, shows inadequate pressure in the southeast region of the distribution system. There is a significant area with pressures modeled below 40 psi.

Project Benefits

The Southeast Elevated Storage Tank will help boost the water pressure to acceptable levels, provide ample fire protection storage, ensure continuous water supply during peak demands, create additional capacity to promote business development, and provide emergency reserves in the event of mechanincal failure at a pump station.

Estimated Cost = $1,766,500

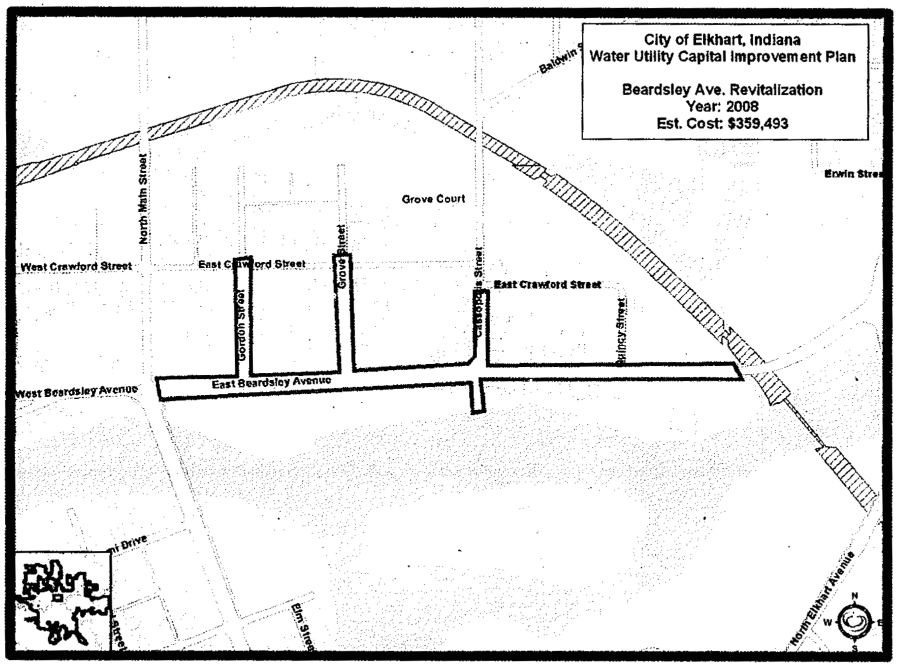
Beardsley Avenue Water Main Replacement - 2008



Project Description

Elkhart's Long Term Control Plan has led the City to separate the combined sewer in this area. This project replaces all of the existing City infrastructure on Beardsley Avenue from North Main Street east to the Railroad Tracks, including 3,000 feet of 12″ water main. The existing water main is approaching 100 years of age and is cast iron pipe. It is very susceptible to breaking and leaking, and is a possible conduit for system contamination. The Water Utility funds would replace the water main only, on this project.

Project Location



Project Need

The cast iron water main is approaching 100 years old and is vulnerable to breaks. The streets on this project are already being removed and replaced as part of the Combined Sewer Overflow plan. This project would pay for the removal and replacement of the water main, which is at the end of its useful life.

Project Benefits

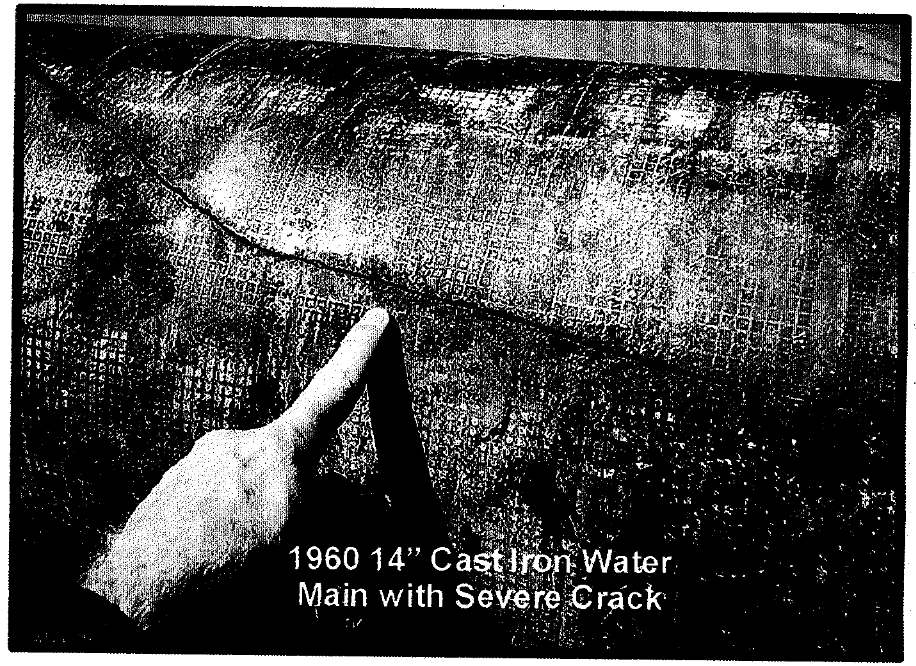
Combining the water and sewer projects will save the water utility nearly $1.8 million. The water mains will be significantly more reliable and the water quality will be enhanced.

Total Estimated Cost = $2,675,000
Water Utility Cost = $360,000

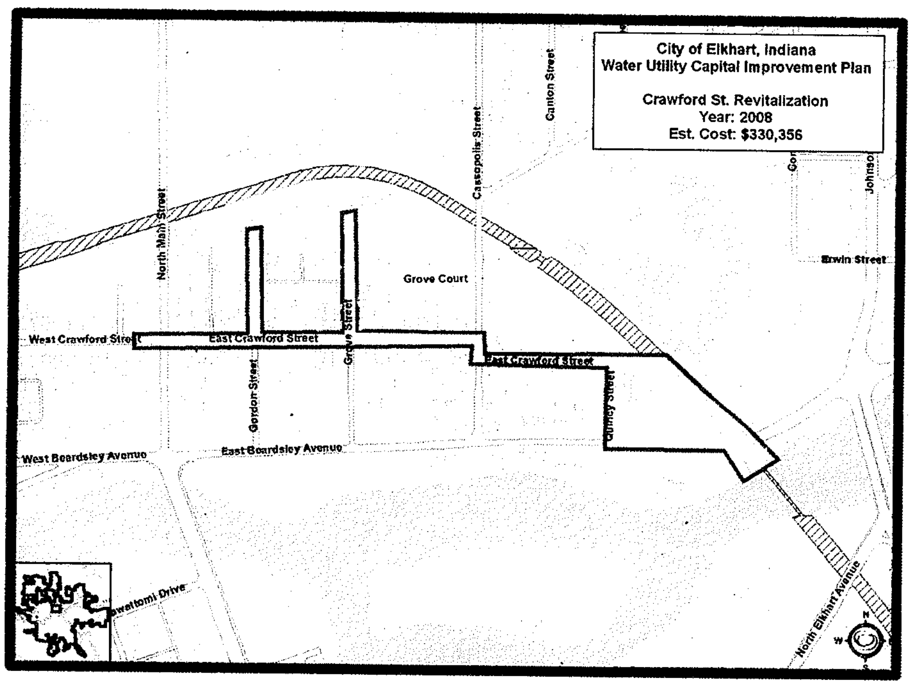
Crawford Street Water Main Replacement - 2008

Project Description

This project replaces all of the existing City infrastructure on Crawford Street from North Main Street east to the railroad tracks as part of their CSO Long Term Control Plan. It includes 950 feet of 8" and 2,100 feet of 10" water main. The existing cast iron main is approaching 100 years old. It is vulnerable to breakage and leaking, thus, it could be a conduit for system contamination. The Water Utility funds would replace the water main only, on this project.



Project Location



Project Need

The cast iron water main is approximately 100 years old and is susceptible to breaks. The streets on this project are already being replaced as part of the combined sewer separation project. This project would pay for the removal and replacement of the water main, which is at the end of its useful life.

Project Benefits

Combining the water and sewer projects will save the Water Utility over $1.4 million. The water mains will be significantly more reliable and the water quality will be enhanced.

Total Estimated Cost = $2,885,000
Water Utility Cost = $330,000

Johnson Street Widening New Water Main - 2008

Project Description

The Johnson Street widening project is a part of Elkhart County's Transportation Improvement Plan. It includes the widening of the current two lane street to four and five lanes from Brisol Street, north to County Road 6. The City of Elkhart will install new sewer and water mains in the right-of-way before the road is widened. This project includes 2,000 feet of 20″, 110 feet of 16″, and 300 feet of 12″ water main. The Water Utility would only fund the water main installation component of this project.

Project Need

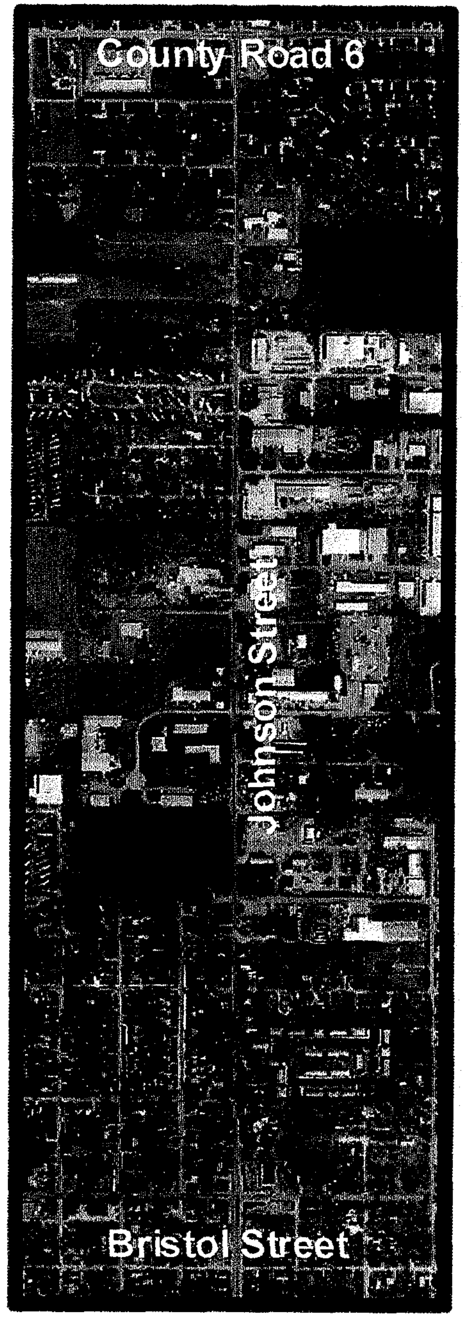
There is significant economic development along this corridor, and the widening of the street will promote continued development. This development will produce an unavoidable demand for water and sewer infrastructure to support it. This project will ensure there is adequate supply and pressure to meet these growing needs.

Project Benefits

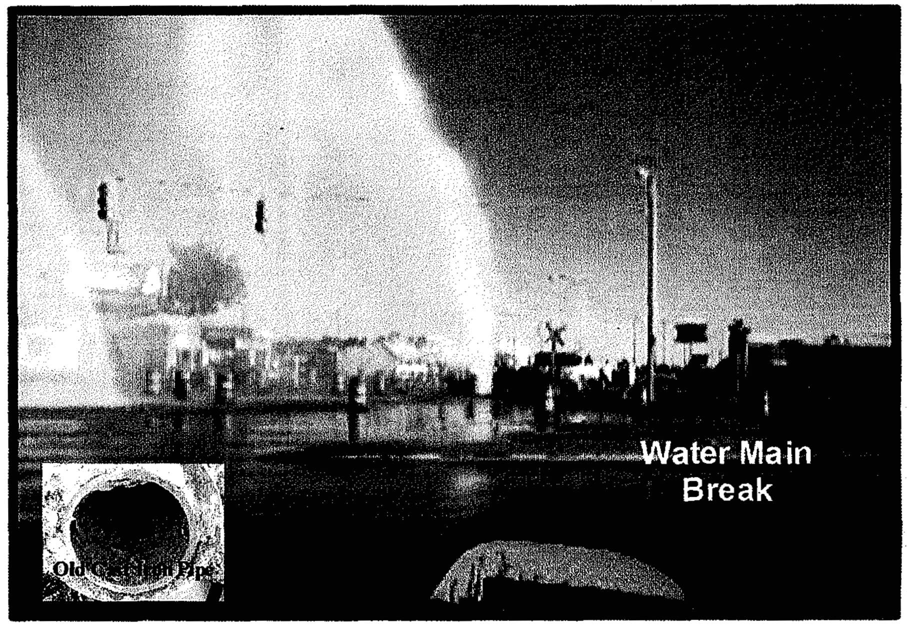
Installing the water mains before the road is constructed, will save the Water Utility millions of dollars in road reconstruction cost. The 20″ water main loop will provide increased water pressure, better fire protection, and greater water supply in this area.

Total Estimated Cost = $6,800,000
Water Utility Cost = $510,000

Project Location



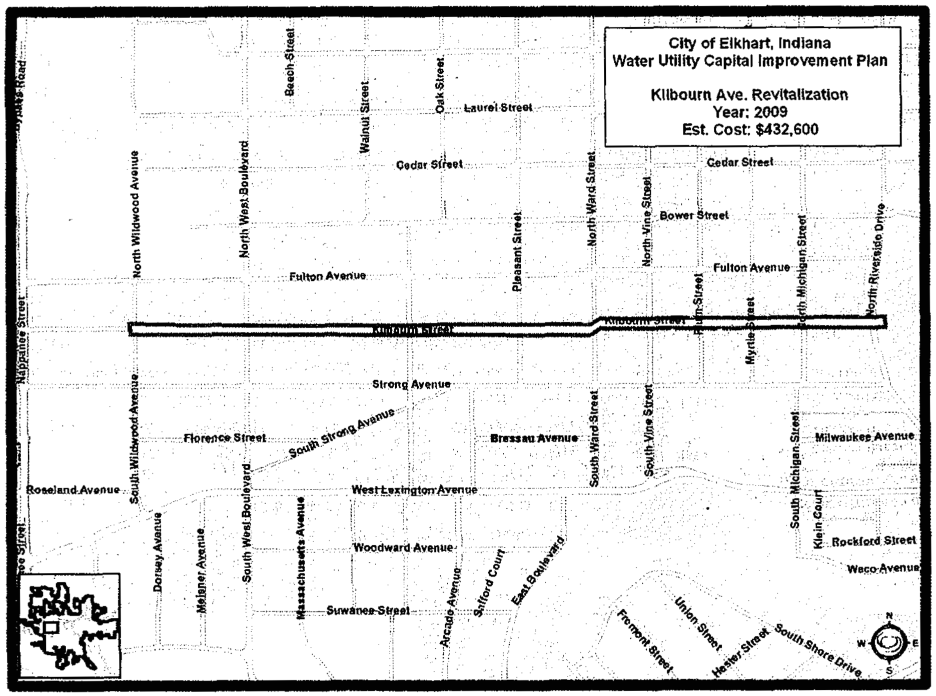
Kilbourn Street Water Main Replacement - 2009



Project Description

This project replaces all of the existing City infrastructure on Kilbourn Street from Wildwood Avenue, east to Riverside Drive as part of the CSO Long Term Control Plan. It includes 5,000 feet of 8″ water main. The existing cast iron main is approximately 90 years old. It is vulnerable to breaking and leaking, and could be a conduit for system contamination. The Water Utility funds would replace the water main only, on this project.

Project Location



Project Need

The cast iron water main is approximately 90 years old and is in poor condition. The streets on this project are already being replaced as part of a combined sewer separation project. This project would pay for the removal and replacement of the water main, which is at the end of its useful life.

Project Benefits

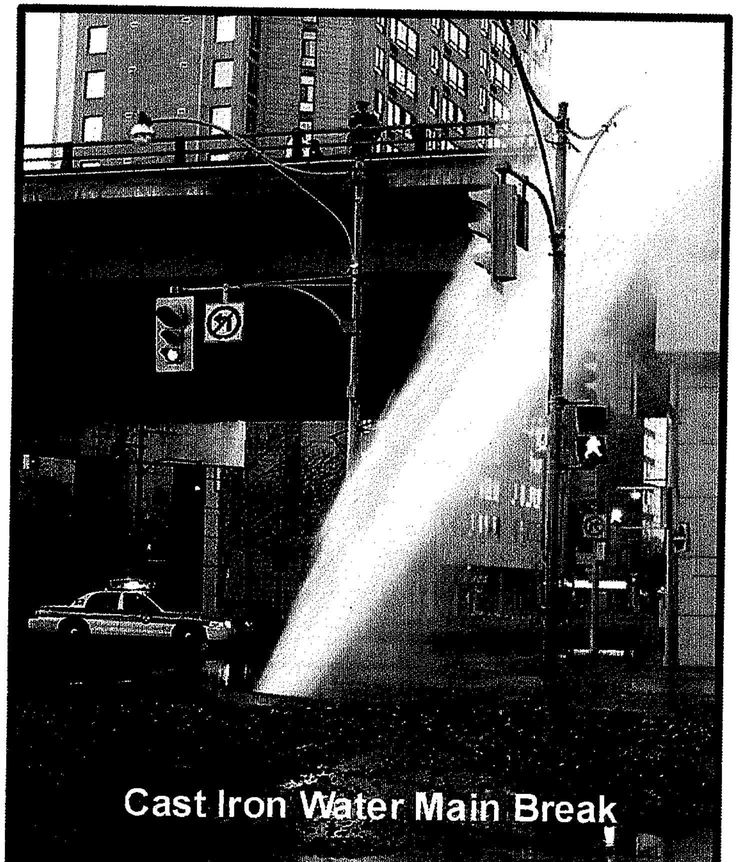
Combining the water and sewer projects will save the water utility over $1.5 million. The water mains will be significantly more reliable and the water quality will be enhanced.

Total Estimated Cost = $3,235,000
Water Utility Cost = $435,000

Fulton Street Water Main Replacement - 2009

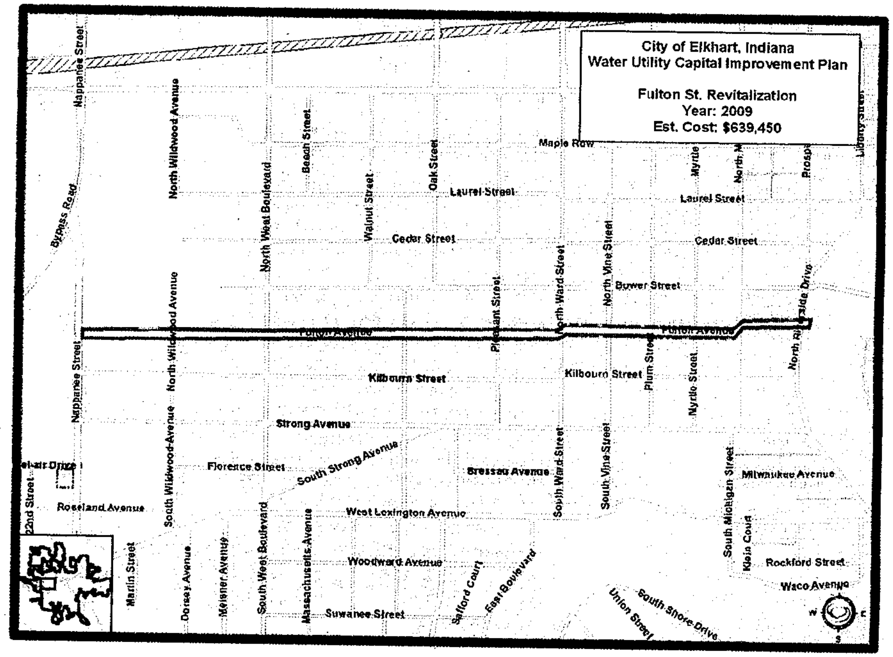
Project Description

This project replaces the existing City infrastructure on Fulton Street from Nappanee Street, east to Riverside Drive, as part of the Long Term Control Plan. It includes 6,500 feet of 8″ water main. The existing cast iron main is around 90 years old. It is vulnerable to breakage and leaking, and, it could be a conduit for system contamination. The Water Utility funds would replace the water main only, on this project.



Cast Iron Water Main Break

Project Location



Project Need

The cast iron water main is around 90 years old and is in poor condition. The streets on this project are being replaced as part of a combined sewer separation project. This project would remove and replace the existing water main, which is at the end of its useful life.

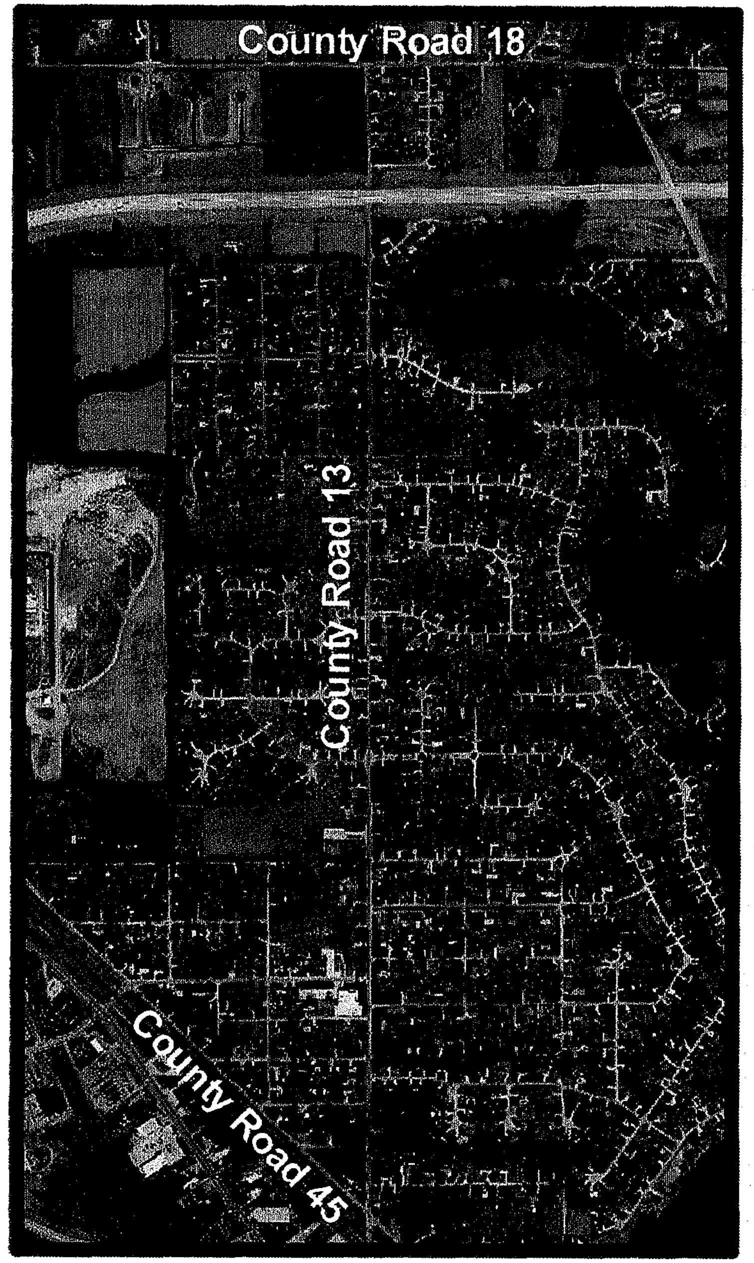
Project Benefits

The water mains will be significantly more reliable and the water quality will be enhanced. Construction of the water at the same time as the sewer will save the water utility over $2.0 million.

Total Estimated Cost = $4,235,000
Water Utility Cost = $640,000

County Road 13 Pressure Loop - 2009

Project Location



Project Description

The County Road 13 pressure loop is one of many distribution system upgrades planned to help Elkhart meet the pressure and flow demands on the periphery of the system. This project includes 7,600 feet of new 24″ water main on the southeast side of Elkhart. The project connects two existing 24″ water mains on County Road 18 and County Road 45.

Project Need

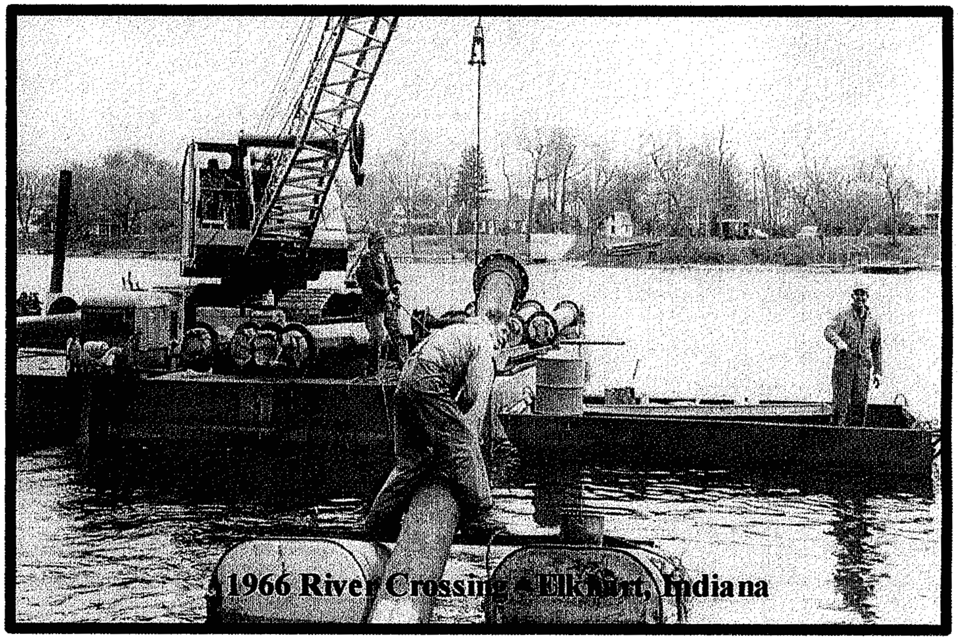
Continued growth and development on the east side of Elkhart has increased the demand for water. The current system demands, and the future maximum day demands for 2015, were modeled using a 3 MGD and 1 MGD three hour fire at Elkhart General hospital and on the east side of Elkhart, respectively. Under these conditions, there is insufficient water pressure in this part of the system, with modeled pressures below 20 psi. This 24″ transmission main will close a gap in the existing pressure loop that traverses the outer perimeter of the City, and it will help ensure there is adequate supply and pressure on the southeast side to meet the growing needs.

Project Benefits

This project, when coupled with the increased storage capacity and increased capacity at the South Wellfield, will provide increased water pressure, better fire protection, and greater water supply in southeast Elkhart.

Total Estimated Cost = $1,726,500

Okema & Edgewater 24″ River Crossing - 2009

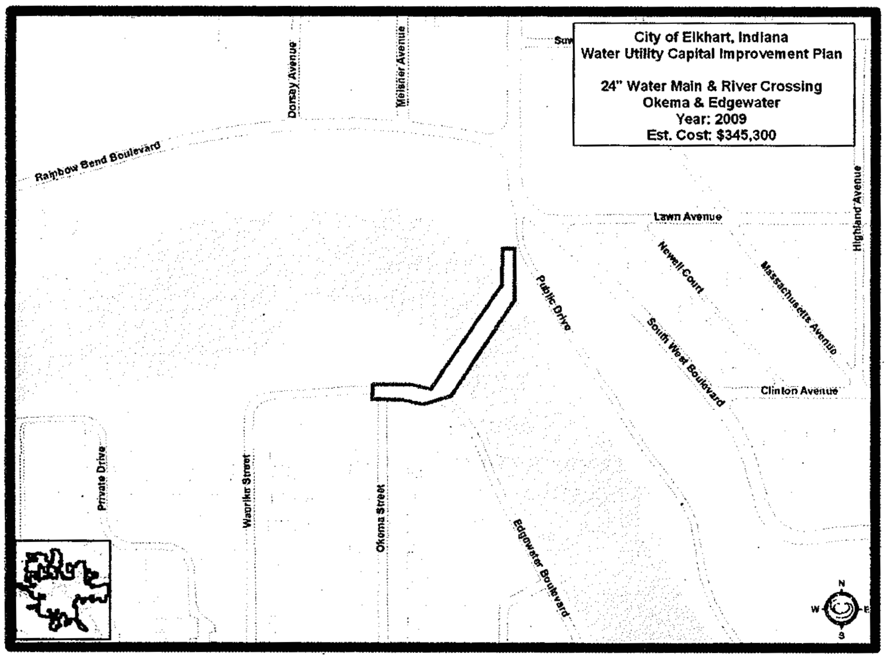


1966 River Crossing - Elkhart, Indiana

Project Description

The Okema & Edgewater River Crossing is Phase I of a larger water distribution system project that closes gaps in the 24″ pressure loop through Elkhart. The project includes 500 feet of 24″ water main. Phase II of the project would link the River Crossing to Rainbow Bend & Dorsey and would also be completed in 2009. Phase III consists of 24″ water main on State Road 19 from Lusher to Franklin, and the final Phase is 24″ water main on Pennsylvania & Okema, both of which would be constructed in 2010.

Project Location



Project Need

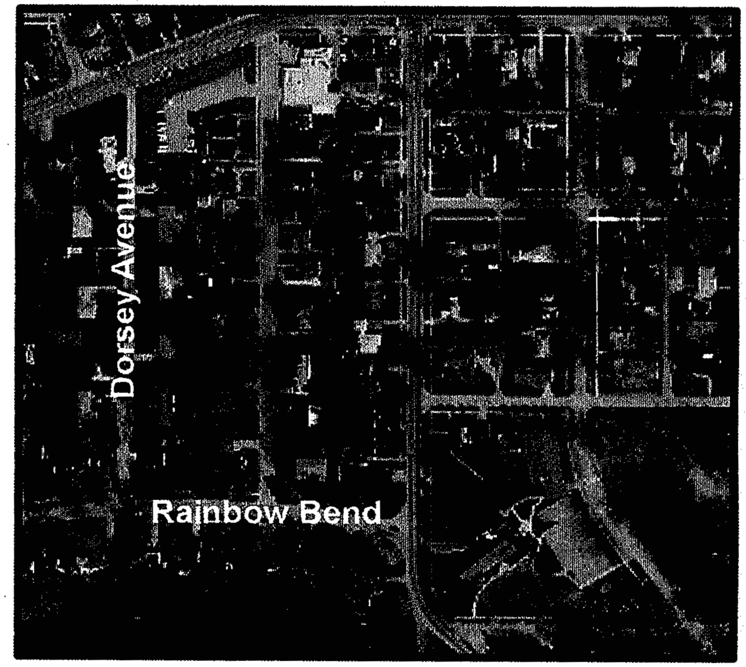
The projected demand on the existing distribution system reveals substantial inadequacies in pressure and flow. The deficient pressure migrates significantly westward from the eastern and northern perimeters of the service area, and places much of the service area at risk of poor performance. The deficiency is largely due to conveyance constraints.

Project Benefits

This project, with its subsequent phases, drastically improves efficiencies in the conveyance of water throughout the service area, and when connected with an increased water supply, will acceptably mitigate the pressure and flow deficiencies in the system.

Total Estimated Cost = $345,300

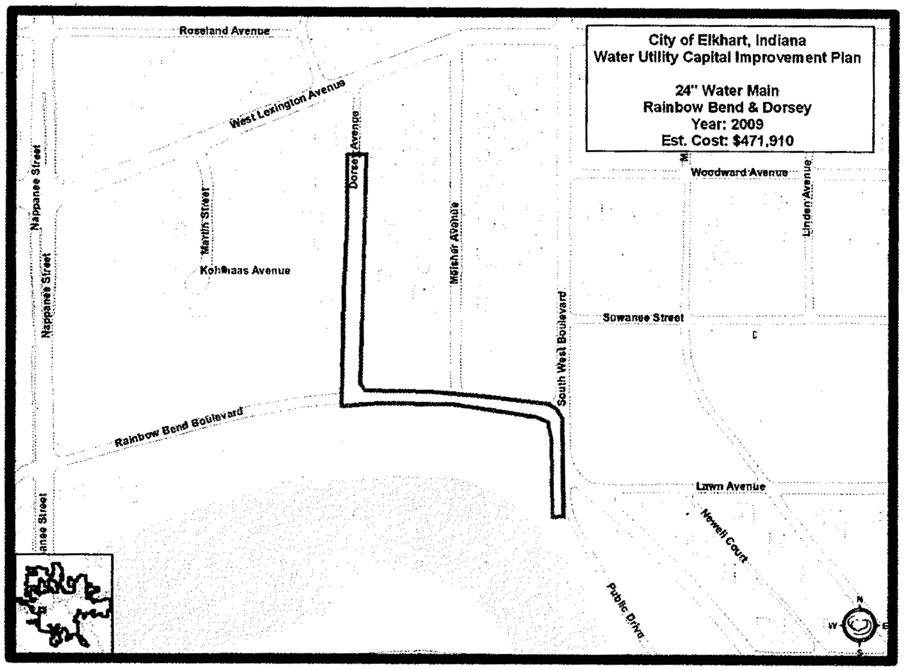
Rainbow Bend & Dorsey 24″ Water Main - 2009



Project Description

The project includes 1,700 feet of 24″ water main starting from the Phase I River Crossing and traversing along Rainbow Bend and down Dorsey Avenue. This is the second phase of the larger water distribution system project that closes gaps in the 24″ pressure loop through Elkhart. Phase III consists of 24″ water main on State Road 19 from Lusher to Franklin, and the final Phase is 24″ water main on Pennsylvania and Okema, both of which would be constructed in 2010.

Project Location



Project Need

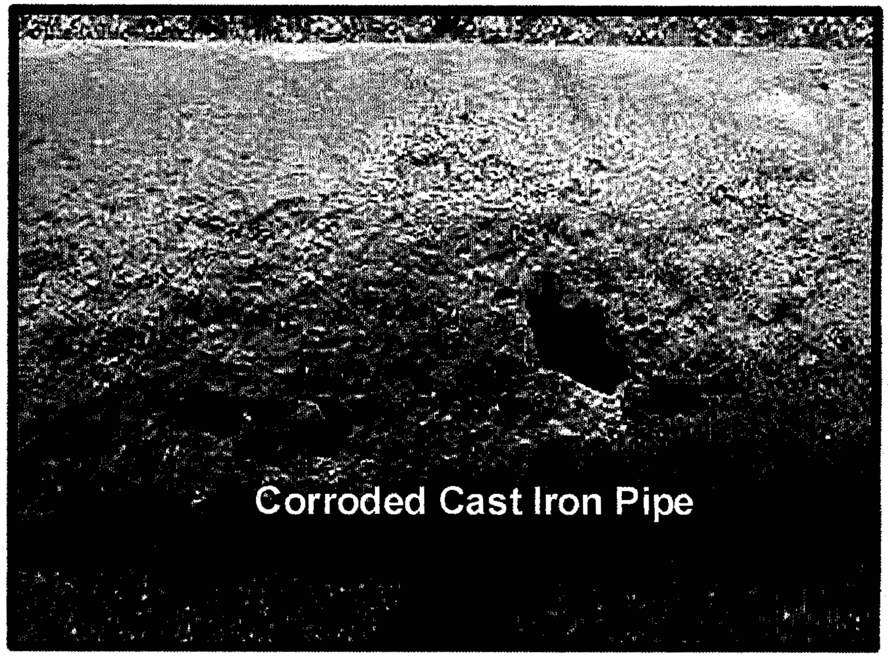
The projected demand on the existing distribution system reveals substantial inadequacies in pressure and flow. The reduced pressure migrates significantly westward from the eastern and northern perimeters of the service area and places much of the service area at risk of poor performance. The deficiency is largely due to conveyance constraints.

Project Benefits

This multi-phased project drastically improves efficiency in the conveyance of water throughout the service area, and when connected with an increased water supply, will acceptably mitigate the pressure and flow deficiencies in the system.

Total Estimated Cost = $471,910

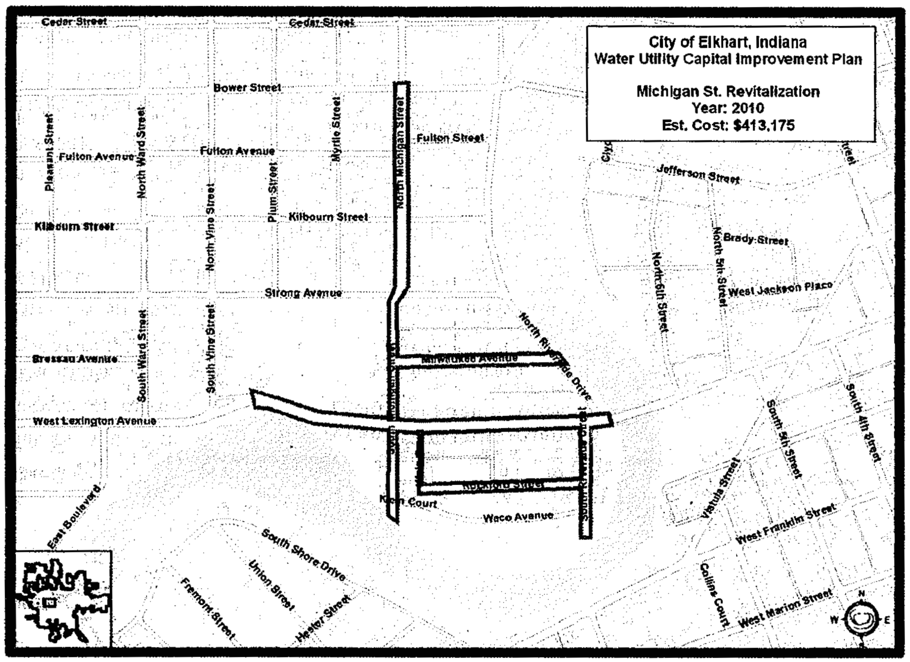
S. Michigan Street Water Main Replacement - 2010


Corroded Cast Iron Pipe

Project Description

Existing City infrastructure on S. Michigan Street from Bower Street, south to the St. Joseph River, will be replaced, as well as portions of Milwaukee Avenue, West Lexington Avenue, and Rockford Street. The project includes 2,000 feet of 12″ and 3,500 feet of 8″ water main. The existing cast iron main is approximately 90 years old. It is at risk of breaking and leaking and may be a future conduit for system contamination. The S. Michigan Street project is a part of Elkhart's CSO Long Term Control Plan. The Water Utility would only fund the water main component of this project.

Project Location



Project Need

The cast iron water main is approximately 90 years old and is in poor condition. The streets on this project are already being replaced as part of a combined sewer separation project. This project would pay for the removal and replacement of the water main, which is at the end of its useful life.

Project Benefits

Combining the water and sewer projects will save the water utility over $1.7 million. The water mains will be appreciably more reliable, and the water quality will be enhanced.

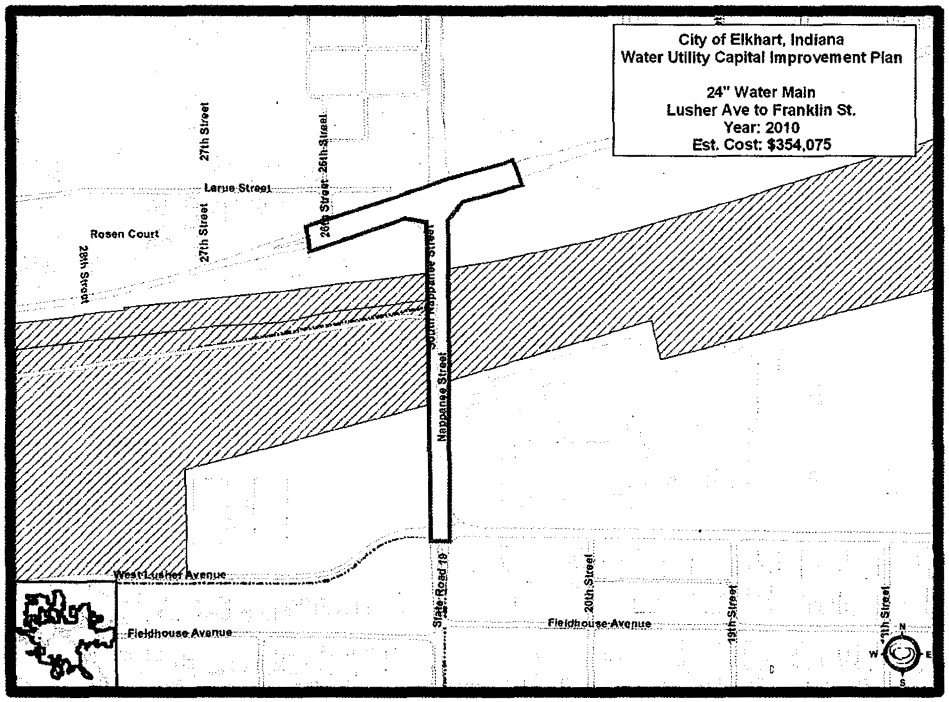
Total Estimated Cost = $3,220,000
Water Utility Cost = $415,000

State Road 19 - Lusher to West Franklin - 2010

Project Description

The project includes 1,500 feet of 24″ water main starting on State Road 19 at Lusher Avenue and continuing north to West Franklin Street. This is the third phase of the larger water distribution system project that closes gaps in the 24″ pressure loop through Elkhart. This phase is scheduled to be constructed at the same time as the State of Indiana's reconstruction of State Road 19. The final phase of this project continues the 24″ water main on Pennsylvania and Okema and is also scheduled for 2010.

Project Location



Project Need

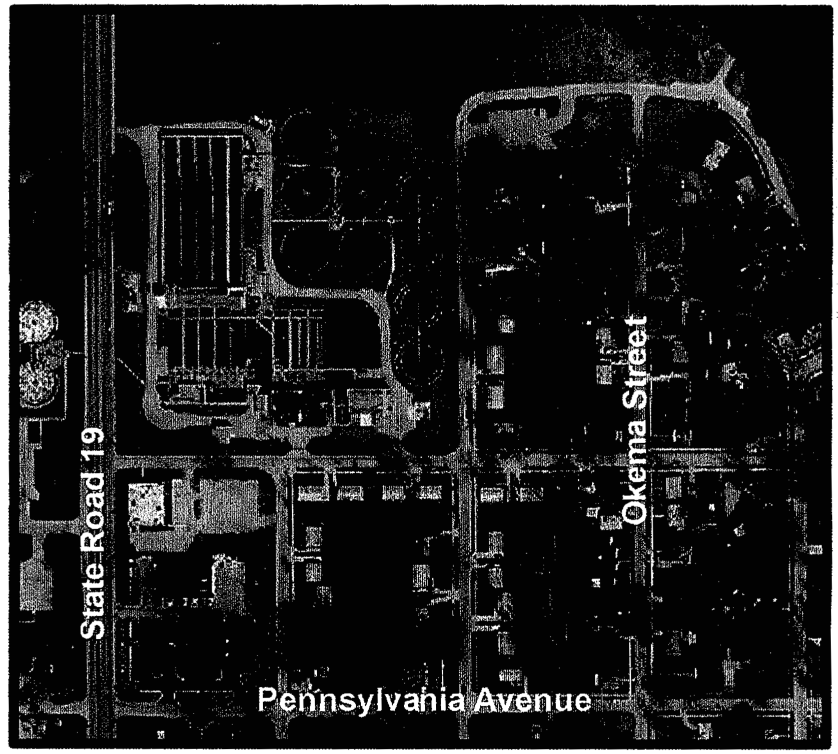
The projected demand on the existing distribution system reveals substantial inadequacies in pressure and flow. The deficient pressure migrates significantly westward from the eastern and northern perimeters of the service area and places much of the service area at risk of poor performance. The deficiency is largely due to conveyance constraints.

Project Benefits

This multi-phased project drastically improves efficiency in the conveyance of water throughout the service area, and when connected with an increased water supply, will acceptably mitigate the pressure and flow deficiencies in the system.

Total Estimated Cost = $354,075

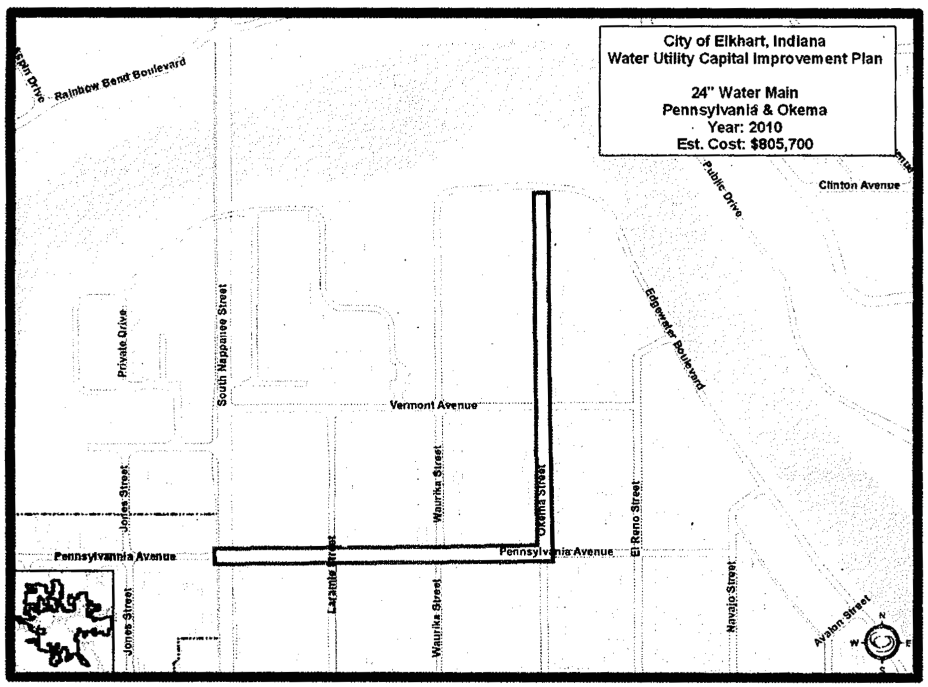
Pennsylvania & Okema 24″ Water Main - 2010



Project Description

The project includes construction of 3,000 feet of new 24″ water main on Pennsylvania Avenue from State Road 19 to Okema Street. It then continues north on Okema to the River Crossing. This is the final phase of the larger water distribution system project that closes gaps in the 24″ pressure loop through Elkhart. This phase is also scheduled to be constructed in 2010, coinciding with the State of Indiana's reconstruction of State Road 19.

Project Location



Project Need

The projected demand on the existing distribution system reveals substantial inadequacies in pressure and flow. The deficient pressure migrates significantly westward from the eastern and northern perimeters of the service area and places much of the service area at risk of poor performance. The deficiency is largely due to conveyance constraints.

Project Benefits

This multi-phased project drastically improves efficiency in the conveyance of water throughout the service area, and when connected with an increased water supply, will acceptably mitigate the pressure and flow deficiencies in the system.

Total Estimated Cost = $805,700

GREELEY AND HANSEN

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www.greeley-hansen.com

September 26, 2005

Ms. Laura E. Kolo
Operations Assistant
Public Works & Utilities
1201 S. Nappanee Street
Elkhart, IN 46516

Subject: North Main Street Pumping Station Evaluation
Technical Memo Draft For Review

Dear Laura:

Enclosed is a copy of the technical memo for your review and consideration. I have not included the figures as they have not been altered since our meeting on Wednesday the 21st. Please review the revised text and let me know if there are modifications or additions that we should make to finalize the memo. We will be completing an internal review in the interim.

Yours very truly,

Greeley and Hansen

Stan

Stanley S. Diamond
Associate

SSD/ssd

c: Ron Martin

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APPENDIX

A

ELKHART, INDIANA
PUBLIC WORKS AND UTILITIES

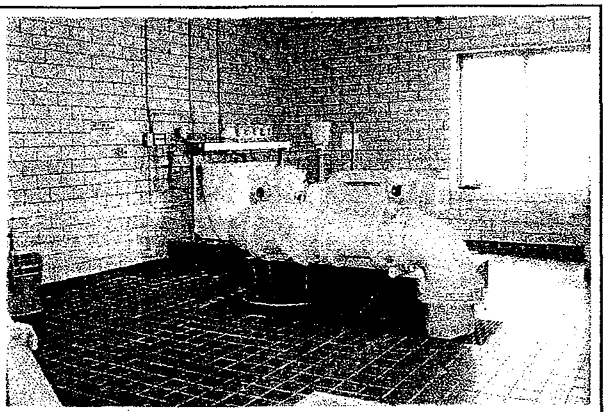
North Main Street Pumping Station Evaluation
Technical Memorandum

Greeley and Hansen LLC

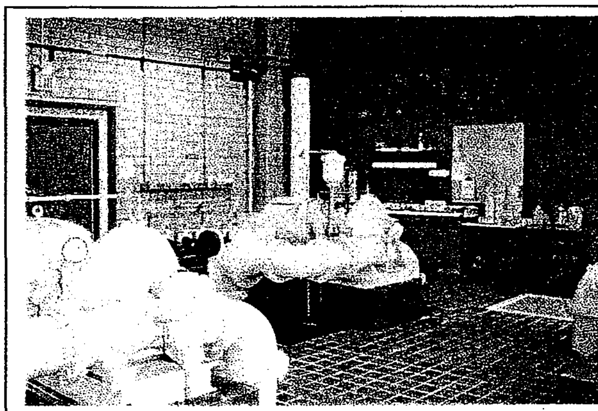
September 2005

1. Background

Elkhart's primary water source is the North Main Street Well Field. A plan of the Well Field is provided on **Figure 1**. Water is drawn from wells and discharged into one of two ground storage tanks on the north side of Christiana Creek. As needed, high service pumps located in the North Main Street Pumping Station on the south side of Christiana Creek, are used to draw water through the three suction mains from the ground storage tanks and pump it into the distribution system. Chlorine, hydrofluosilicic acid and polyphosphates are added for disinfection, dental hygiene and iron sequestering, respectively. The Pumping Station structure was originally constructed in the early 1920's and contained coal fired boilers and steam driven pumps. Today, there are five electrically powered, horizontal split-case high service pumps in the Station. The firm capacity of the Pumping Station, with the largest pumping unit out of service, is 15½ million gallons per day (mgd).



High Service Pump - 6



High Service Pumps - 3 & 5

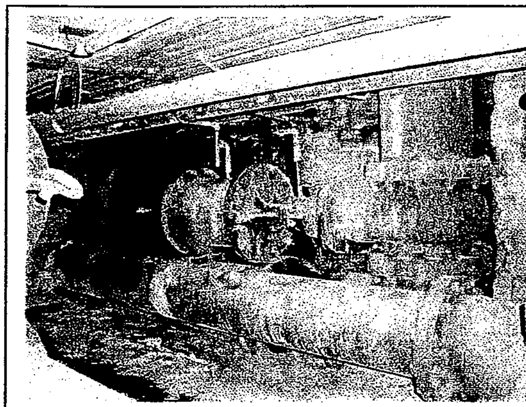
The flows through the three water mains that convey water from the ground storage tanks under Christiana Creek into the lower level of the Pumping Station are metered. The meters are located in a vault on the north side of the Station. **Figure 2** shows the piping and valves in the lower level of the Pumping Station. There are isolation valves on each of the suction mains just inside the lower level. The three mains then connect to a common suction header. There are isolation valves on the common header between the mains that when coupled with the pump discharge valves can be used to isolate portions of the pumping system. There are five lines running from the common suction header to the high service pumps. Additional isolation valves are provided on some of those lines so that the 2-1/4 and 4-1/4 mgd pumps can be run off of different suction lines. Isolation valves are provided on all of the pump suction and discharge lines. The suction and discharge valves that are in the vertical piping extending up to and down from the pumps are indicated by dashed "X's" in the circles where pipes are vertical.

The existing electrically driven high service pumps were originally installed in the mid 1940's. Al l five high service pumps have been replaced in the years shown in the following table.

Pump Designation	Pump Capacity (mgd)	Year Replaced
HSP-2	2-1/4	2003
HSP-3	3-1/2	1987 (Overhauled 1999)
HSP-4	4-1/2	2001
HSP-5	5-1/4	1991
HSP-6	6	2002

The primary power supply panel and metering equipment, motor control center, and instrumentation and controls were all replaced in 1991. Additions and modifications have been made to the chemical storage and feed equipment during the past three years by Elkhart personnel. In addition to the high service pumps and chemical storage and feed equipment, the North Main Street Pumping Station also houses a diesel standby generator, a water meter service area, and an office area where utility customers can pay utility bills.

The goal of this project was to assess the current condition of the structure and the equipment and to make recommendations for the rehabilitation or replacement of the North Main Street Pumping Station. Of primary concern were the valves and piping in the lower level of the Pumping Station that convey water to and from the high service pumps, but also of concern are the chemical storage and feed systems.


Typical Valve & Actuator

Most of the isolation valves are double disk gate valves manufactured by "Eddy Valves" out of Waterford, New York, which was absorbed by The Clow Valve Company in the 1940's. Most of the valves have hydraulic actuators that are no longer operational. Almost all of the isolation valves are in the lower level of the Pumping Station which has been designated as a confined space. The valves are difficult to get to, are not being exercised, and have received little if any maintenance through the years. There is evidence that a few of the valves were actuated when the high service pumps were sequentially replaced. Elkhart Public Works & Utilities personnel are reluctant to actuate any of the valves for fear that they will malfunction and impair the operation of the Station.

They have similar concerns about actuating the buried valves on the high pressure lines just outside of the Pumping Station. While the piping and valves in the Station are arranged so that portions of the pumping equipment can be isolated when needed for maintenance and inspection, without the ability to actuate the valves the reliability of the Station is compromised.

Repair Or Replacement Issues

Public Works & Utilities personnel have expressed concern about operating the isolation valves on the high pressure discharge lines just outside of the Pumping Station, but operation of the valves will be required if the Station is going to be kept in operation while the interior valves in the lower level are replaced. Therefore, one of the first tasks in any replacement program will be to test the buried high pressure isolation valves and replace them if need be. Replacement of the isolation valves may require isolating and depressurization of portions of the distribution system interrupting service to some customers for a period of time.

In addition to being in a confined space, moisture levels in the lower level of the Pumps Station are high. The check valve on the 5-1/4 mgd pump is positioned so close to the pump base that the shaft cannot be packed. A steady stream of water about 3/8 to ½ inch in diameter is spraying out of the side of the valve introducing additional moisture into the space on a continuous basis.


5 mgd Leaking Check Valve


Continuously Wet HSP-5
Discharge Valves & Piping

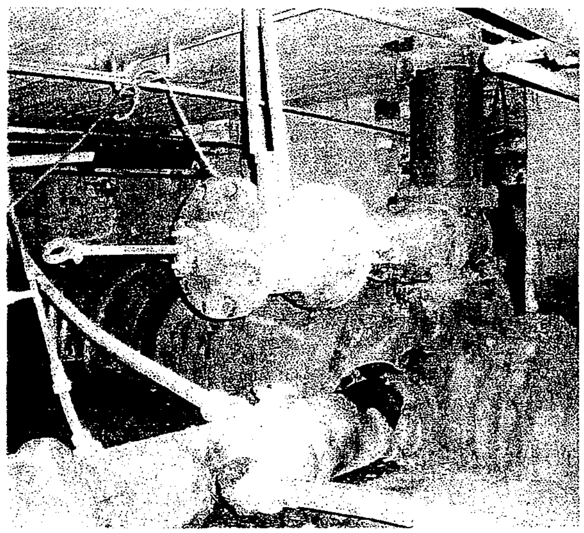
The high moisture levels have increased corrosion rates of the exposed metals, particularly the bolts and nuts used on the flanged connections. Before any repair or replacement work is initiated, all of the exposed bolts that show significant corrosion should be carefully replaced.


Embedded Valve and Pipes

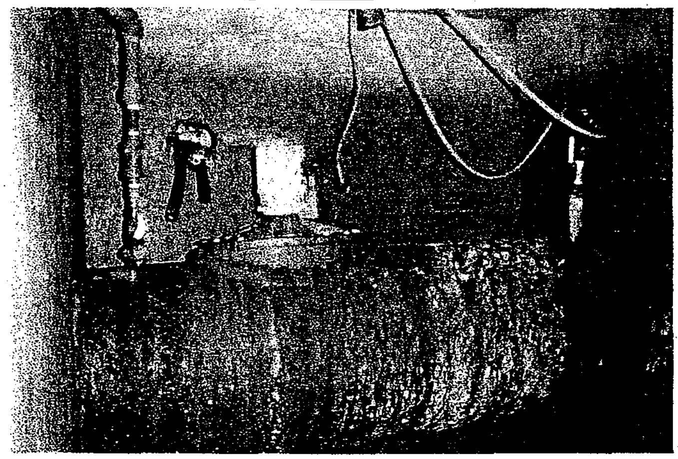
At some point in the past concrete was placed in the lower level to create a solid floor. Nine or ten of the valves and some of the piping segments were partially submerged in the concrete. The concrete around the lower portion of the valve flanges will have to be removed using hydraulic hammers before the valves can be removed and replaced. Once the valves have been replaced something will have to be placed in the pockets created below the valves so water does not pool and remain below and around the new valve flanges, or the floor will need to be lowered so that there is positive drainage to the existing sump pit below the Electrical/Control Room.

There are no couplings in the piping, and the partial embedment of some of the piping system and valves restricts movement of the piping systems. The subsequent rigidity of the piping systems will make it more difficult to remove and replace the valves.

All of the hydraulic pipes to the various valve actuators have been severed, but none of the hydraulic piping has been removed. The presence of the actuator and the associated hydraulic piping restricts the space. There are also two or three horizontal steel tanks in the lower level that were reportedly used in conjunction with the air release valves on the pumps to maintain the prime on the pump suction lines. These tanks are no longer being used, but have not been removed and further restrict the lower level space.


HSP-2 Discharge Valve Actuator
With Severed Hydraulic Lines

There are a number of other process lines in the lower level. The six and eight inch lines and valves south and east of the 4-1/2 mgd pump contain a surge relief valve, which when activated discharges water through the square chamber in the northeast corner of the structure into a drain which subsequently discharges to the adjacent creek. The 12-inch main partially embedded in the floor of the lower level east of the 4-1/2 mgd pump reportedly serves as the water supply to the Pumping Station. There is also a 3-inch galvanized line running from the high pressure discharge line back into the 3-1/2 mgd pump suction line. That line contains a manual gate valve, which is closed. The valved line, partially visible in the picture on the



West Suction Line & Meter
With Chemical Feed Lines

preceding page, was most likely installed so that the 3-1/2 mgd pump could be manually primed when the water levels in the ground storage tanks were low. The chemical feed lines for the chlorine, fluoride and polyphosphate systems all pass through the lower level on route to the suction meter vault.

The setting of the surge relief valve and whether or not it opens periodically or would open when the pressure setting is reached, however, is unknown. Pressures in the discharge piping should be monitored, particularly when pumps are shut off, and the information should be used to estimate what the surge pressures would be during a power failure when the Station is operating at capacity. That information should in turn be used to evaluate the adequacy of the existing surge relief system.

The 12-inch main that serves as the water supply into the station should be replaced with a properly sized and metered service. A backflow prevention device should be installed on the new service line to make certain that the chemical or potential contaminants are not drawn into the finished water system through the service line during low pressure events.

The presences of the chemical process lines add additional hazards to Public Works & Utilities personnel that enter the lower level space. Careful attention will have to be given to the identification and protection of the chemical process lines during any valve or valve and pipe replacement process.

Elkhart Public Works & Utilities personnel have recently cut two additional access openings in the floor of the Pumping Room to improve access to the valves and pipes in the lower level. Additional openings may be beneficial if replacement of the valves and pipes is determined to be the appropriate solution.

2. Alternative Replacement Scenarios

The following four progressively more extensive valve replacement scenarios were developed for comparison purposes and are shown on **Figures 3, 4, 5 and 6**. The more extensive the valve replacements program undertaken, the greater the reliability and operational flexibility returns will be realized. Due to the critical nature of the surge relief system and the water service into the Pumping Station, costs were included under all four valve replacement alternatives for the replacement of both systems.

- **Essential Valve Replacement - Alternative A** includes the replacement of the 20" suction isolation valve in between the west and central suction lines, and the HSP-5 suction and discharge valves. (Optional replacement of the buried discharge isolation valves on Optional replacement of the HSP-2 SAV valves if they are not operable.)

- **Secondary Valve Replacement – Alternative** B includes the replacement of both 20" suction isolation valves in the suction header, and the HSP suction and discharge valves. (Optional replacement of HSP-2 and HSP-4 SAV valves if they are not operable.)

- **Comprehensive Valve Replacement - Alternative C** includes the replacement of all of essentially all of the valves in the lower level of the Pumping Station.

- **Comprehensive Valve And Pipe Replacement - Alternative D** includes the replacement of all of essentially all of the valves in the lower level of the Pumping Station and the replacement of the pipes that are embedded in the floor. While the valves and piping are being replaced the bulk of the existing floor would also be removed and a new floor would be poured at a slightly lower level. The new floor would either be sloped to the existing sump pit or a floor drainage system would be installed below it to insure that any water introduced into the area would drain to the sump pit.

Preliminary replacement sequences for Alternatives A and B are developed for planning purposes. Copies of those replacement sequences are attached. Similar replacement sequences will have to be developed if Alternatives C or D should they be selected for implementation.

3. Pump Station Replacement Alternative

While the various valve replacement alternatives will improve the operability and reliability of the North Main Street Pump Station, implementing any of the four valve and pipe replacement alternatives will be difficult, require careful planning and sequencing, involve some risk due to the nature of the space and the critical nature of the facilities, and only provide limited benefits. Modifications to the portion of the structure housing the chemical storage and feed equipment were not included in the valve and pipe replacement alternatives. Significant modifications to the existing structure and the mechanical systems would have to be made to bring the chemical system into compliance with current building and safety codes or a new chemical building would have to be built to house them. Even if the most extensive valve and pipe replacement alternative was performed, the lower level of the Pumping Station will still have to be considered as a confined space and present housekeeping and maintenance challenges. The useful life of the pumping systems would be extended somewhat, but the expected useful life of the pumping systems will be less than what a new facility in a new structure would be.

Once in service, the new suction line will enhance the overall reliability of the suction piping system insuring that Elkhart will be able to operate the station at capacity even if one of the older suction lines fails or is damaged.

Both new pumping stations would have lower level piping galleries that would house the valves, piping, and vertical turbine cans that the new high service pumps would be place in. The electrical equipment and motors powering the vertical turbine pumps would all be located on the ground floor minimizing the potential that they could be damaged by emersion. The lower level galleries would be designed to comply with the current building and fire codes, and access for operations and maintenance would be greatly improved.

Both new pumping stations would be designed to house the storage and feed equipment for the hydrofluosilicic acid which is currently used to fluoridate the finished water. Hydrofluosilicic acid is aggressive and current codes require isolation of the storage and feed area from the rest of the structure. Codes also require continuous ventilation, backup power, secondary containment, and instrumentation and controls to facilitate continuous monitoring of the system and alarms. Both new pump station alternatives assume that the existing gaseous chlorine system would be replaced with a sodium hypochlorite system. Under the first alternative, with the new pumping station to the west, the existing pumping station would be rehabilitated and modified so that the new sodium hypochlorite and polyphosphate facilities could be housed within that structure. Under the second alternative, with the new pumping station to the south, room would have to be allocated within the new structure to house the new sodium hypochlorite and polyphosphate facilities.

4. Opinion of Probable Cost

Probable costs for the four valve replacement alternatives and the two new pump station alternatives were developed for comparison. Probable cost for a new chemical building was also developed so that an annual cost comparison could be made between the comprehensive valve and pipe replacement alternative and the new station alternatives. Budget costs for the equipment like the valves, actuators, larger piping, and pumps were obtained from equipment suppliers. Installation costs were developed with input from a local contractor that specializes in constructing and rehabilitating municipal water and wastewater facilities. On the valve replacement alternatives contingencies of 30 percent were included in the costs opinions to cover costs for unforeseen modifications and additions that generally develop when rehabilitating and modifying existing facilities. An additional 35 percent was included to cover engineering and administrative costs through the completion of the rehabilitation project. Higher engineering and administrative cost percentage were included in the replacement alternatives cost opinions so that the critical tasks of evaluating and replacing the surge relief system can be performed and all of the existing conditions and construction sequencing issues can be carefully spelled out in the construction contract documents so that potential bidders clearly know what they will be dealing with and change orders can be kept to a minimum. For the new pumping station alternatives, where the existing conditions, sequencing issues and construction hazards are less of a factor, a contingency of 15 percent was used along with an additional 20 percent for engineering and administrative costs.

The spreadsheets developed in the process of preparing the opinion of probable costs for the various alternatives are attached. Following is a tabular summary of the valve and pipe replacement opinion of probable costs.

Alternative A – Essential Valve Replacement	*Alternative B – Secondary Valve Replacement*	*Alternative C – Comprehensive Valve Replacement*	*Alternative D – Comprehensive Valve and Pipe Replacement*
$320,000	$460,000	$680,000	$1,300,000

The probable cost to construct a new chemical building housing new chemical storage and feed equipment is $4,000,000. Following is a tabular summary of the new pumping station opinion of probable costs.

New Pumping Station - West	*New Pumping Station - South*
$12,000,000	$13,300,000

Attached **Table 1** shows the annual costs of the Comprehensive Valve and Pipe Replacement Alternative summed with the annual costs for a new chemical building compared to the annual costs for the two new pumping station alternatives are shown in the following table. Even though the annual cost for the Comprehensive Valve and Pipe Replacement Alternative when summed with the annual cost for a new chemical building are lower than the new pumping station annual costs, the present worth cost for a new station which would be needed when the existing station reaches the end of its useful life have not been included.

5. Recommended Alternative

The pumping and electrical systems in the existing pumping station are in reasonably good condition and if maintained properly can be expected to provide continued serve for at least another 10 to 15 years. Some level of valve replacement in the lower level of the existing pump station is recommended if the station is going to continue to be used for that time period, and consideration should be given to the addition of a new chemical building to bring those facilities and the physical spaces they are housed in into compliance with existing codes. Given the limited benefits realized for the costs that will be incurred with the valve and pipe replacement alternatives, and the significant additional costs that would be incurred to bring the existing chemical systems into compliance with current codes, Elkhart should move forward with the replacement of the pumping station. Of the two new pumping station alternatives, the station located to the west of the existing pumping station is recommended. Positioning the new pumping station west of the existing station as shown has the following benefits:

- The existing station and the residences on Crawford Street will screen the new station somewhat from public view and make it easier to secure (the new pumping station to the south would be in full view of the public on both Main and Crawford streets and more vulnerable to accidental or intentional damage by vehicular traffic),

- Suction hydraulic losses will be lower with the new pumping station nearer to the existing ground storage tanks (the new pumping station to the south is further away from the ground storage tanks so suction hydraulic losses would be greater),

- Excavation and structural costs will be lower with the new pumping station being constructed on ground that is at roughly the same elevation as the ground where the existing pumping station is (the new pumping station to the south would be constructed on higher ground but would have to be just as deep, so excavation and structural costs will be greater),

- Public Works & Utilities will be able to continue to use the existing drive way and fences to gain access and secure the site with minimal impact on the other operations that are conducted on the site (the new pumping station to the south would take the space currently used for parking by the public paying their utility bills, some form of security fencing would be required and there would be little room for bulk chemical deliveries),

- While the existing metal building housing records would have to be demolished there is additional space available if and when the Public Works & Utilities needs to install more advanced treatment like membrane filtration or ultraviolet disinfection (there is very little available space for additional treatment systems if the new station is built to the south), and

- With the new pumping station relatively close to the existing station the Public Works & Utilities could retrofit the existing structure to house new sodium hypochlorite and polyphosphate storage and feed systems insuring continued beneficial use of the existing structure (the new pumping station to the south being further away would have to be larger so that the sodium hypochlorite and polyphosphate storage and feed equipment could be contained therein).

The costs for a new pumping station with properly designed chemical feed systems are significant, but the additional benefits realized with the longer extended life of the facility; the improved performance, operability and reliability; and the improved safety, both for the Public Works & Utilities personnel as well as the general public, justifies the need for a new pumping station.

ELKHART, INDIANA
PUBLIC WORKS & UTILITIES

North Main Street Pumping Station Evaluation
Opinion of Probable Cost
Annual Cost Comparison

TABLE 1

Greeley and Hansen
September, 2005

Alternative	*Cost ($)*	*Expected Life (Years)*	*Annual Cost ($/YR)*
Comprehensive Valve & Pipe Replacement	$1,300,000	15	$87,000
New Chemcial Building	$4,000,000	50	$80,000
Subtotal	$5,300,000		$167,000
New Pumping Station - West	$12,000,000	50	$240,000
New Pumping Station - East	$13,300,000	50	$266,000

ELKHART, INDIANA
PUBLIC WORKS & UTILITIES

North Main Street Pumping Station Evaluation
Opinion of Probable Cost
Valve And Pipe Replacement Alternatives

Greeley and Hansen
September, 2005

Valve Designation	*Size*	*Type*	*Actuator*	*Notes*	*Equipment Cost*	*Material Cost*	*Labor Cost*	*Total Cost*		*Alternative A*	*Alternative B*	*Alternative C*	*Alternative D*
SL-SIV WEST	20	GATE	HYD	Embedded	$5,000	$2,000	$6,250	$13,250				$13,250	$13,250
SL-SIV CENTER	20	GATE	HYD	Embedded	$5,000	$2,000	$6,250	$13,250				$13,250	$13,250
SL-SIV EAST	20	GATE	HYD	Embedded	$5,000	$2,000	$6,250	$13,250				$13,250	$13,250
SH-SIV WEST	20	GATE	HYD	Embedded	$5,000	$2,000	$6,250	$13,250		$13,250	$13,250	$13,250	$13,250
SH-SIV EAST	20	GATE	HYD	Embedded	$5,000	$2,000	$6,250	$13,250			$13,250	$13,250	$13,250
HSP-2 SAV WEST	10	GATE	HW		$2,500	$900	$1,875	$5,275		$5,275	$5,275	$5,275	$5,275
HSP-2 SAV CENTER	10	GATE	HW		$2,500	$900	$1,875	$5,275		$5,275	$5,275	$5,275	$5,275
HSP-2 SIV	10	GATE	HYD		$2,500	$900	$1,875	$5,275				$5,275	$5,275
HSP-2 DCV*	8	CHECK		On Pump Level	$4,000	$250	$1,000	$5,250				$5,250	$5,250
HSP-2 DIV	8	GATE	HYD		$2,200	$750	$1,650	$4,600				$4,600	$4,600
												$0	$0
HSP-3 SIV	14	GATE	HYD		$3,500	$1,200	$2,625	$7,325				$7,325	$7,325
DEMOBILIZATION								$10,000		$10,000	$10,000	$10,000	$10,000
Sutotal Other Related Construction Costs										**$84,000**	**$86,000**	**$92,500**	**$440,000**
SUBTOTAL COST										$184,000	$260,000	$390,000	$738,000
CONTINGENCY @30%										$55,200	$78,000	$117,000	$221,400
ENGINEERING & ADMIN @35%										$83,720	$118,300	$177,450	$335,790
GRAND TOTAL COSTS (ROUNDED)										**$320,000**	**$460,000**	**$680,000**	**$1,300,000**

ELKHART, INDIANA
PUBLIC WORKS & UTILITIES

North Main Street Pumping Station Evaluation
Opinion of Probable Construction Cost
New Pumping Station - West

Greeley and Hansen
September, 2005

Description	*Quanity*	*Unit*	*Equipment Cost*	*Labor Cost*	*Total Cost*	*Notes*
Demolition						
Existing High Service Pumps	5	ea			$5,000	
Existing Chlorine Facilities	1	ls			$1,000	
Existing Fluoride Facilities	1	ls			$1,000	
Existing Polyphosphate Facilities	1	ls			$500	
Existing Electrical Facilities	1	ls			$1,000	
Yard Piping & Valves						
Chemical Storage & Feed Equipment						
Sodium Hypochlorite Bulk Tanks	3	ea	15000	7500	$67,500	
Sodium Hypochlorite Day Tank	1	ea	2500	1250	$3,750	
Sodium Hypochlorite Feed Pumps	3	ea	3000	1500	$13,500	
HSF Storage Bulk Tanks	2	ea	10000	5000	$30,000	
HSF Day Tank	1	ea	2500	1250	$3,750	
HSF Feed Pumps	2	ea	2500	1250	$7,500	
Polyphosphate Bulk Tanks	2	ea	0	4000	$8,000	Relocate Existing
Polyphosphate Day Tank	1	ea	2500	1250	$3,750	
Polyphosphate Feed Pumps	2	ea	3000	1500	$9,000	
Excavation	2800	cy		8	$22,400	(50 x 100 x 15)/27
Temporary Steel Sheeting	7500	sf		25	$187,500	50' x 100' Excavation with 25' Sheeting
Backfill	1400	cy		5	$7,000	
Dewatering		ls			$50,000	
Reinforced Concrete						
Base Slab	280	cy	200	400	$168,000	(50' x 100') x (1' thick)/27

Pipe Gallery Walls 12' Tall	225	cy	200	500	$157,500	((30 + 30 + 100 + 100) + 2(30')) x 12 x 1.5' thick/27
At-grade Slab with Beams	250	cy	200	600	$200,000	4500 sf x 1.5' thick/27
Superstructure						
Pump Room	1800	sf			$270,000	30' x 60'
Sodium Hypochlorite Room	0	ls			$0	(Locate in Existing Pump Room)
Polyphosphate Room	0	sf			$0	(Locate in Existing Pump Room)
Fluoride Room	300	sf			$45,000	15' x 20'
Electrical Room	700	sf			$105,000	20' x 35'
Generator Room		sf				(Keep generator in existing structure.)
HVAC Room	750	sf			$112,500	25' x 30'
Stairwells	600	sf			$90,000	2 @ 10' x 30'
Hallways	0	sf			$0	
Control Room	300	sf			$45,000	15' x 20'
Lavatory	0	sf			$0	(Not required if station is to be un-manned.)
Retro Fit Existing Pump Station						
Remove Flooring		ls			$1,500	
Remove Pump Pads		ls			$5,000	
Remove Pipe & Valves		ls			$10,000	
Bust Out Subfloor		ls			$5,000	

ELKHART, INDIANA
PUBLIC WORKS & UTILITIES

North Main Street Pumping Station Evaluation
Opinion of Probable Construction Cost
New Pumping Station - South

Greeley and Hansen
September, 2005

Description	*Quanity*	*Unit*	*Equipment Cost*	*Labor Cost*	*Total Cost*	*Notes*
Demolition						
Existing High Service Pumps	5	ea			$5,000	
Existing Chlorine Facilities	1	ls			$1,000	
Existing Fluoride Facilities	1	ls			$1,000	
Existing Polyphosphate Facilities	1	ls			$500	
Existing Electrical Facilities	1	ls			$1,000	
Yard Piping & Valves						
Pump Discharge Valves	5	ea	10000	5000	$75,000	
Chemical Storage & Feed Equipment						
Sodium Hypochlorite Bulk Tanks	3	ea	15000	7500	$67,500	
Sodium Hypochlorite Day Tank	1	ea	2500	1250	$3,750	
Sodium Hypochlorite Feed Pumps	3	ea	3000	1500	$13,500	
HSF Storage Bulk Tanks	2	ea	10000	5000	$30,000	
HSF Day Tank	1	ea	2500	1250	$3,750	
HSF Feed Pumps	2	ea	2500	1250	$7,500	
Polyphosphate Bulk Tanks	2	ea	0	4000	$8,000	Relocate Existing
Polyphosphate Day Tank	1	ea	2500	1250	$3,750	
Polyphosphate Feed Pumps	2	ea	3000	1500	$9,000	
Excavation	3800	cy		8	$30,400	(50 x 100 x 20)/27
Temporary Steel Sheeting	10000	sf		30	$300,000	50' x 100' Excavation with 35' Sheeting
Backfill	1500	cy		5	$7,500	
Dewatering		ls			$35,000	

Reinforced Concrete						
Base Slab	430	cy	200	400	$258,000	((35' x 85') + (60' x 80')) x (1.5' thick)/27
Pipe Gallery Walls 12' Tall	225	cy	200	500	$157,500	((30' + 30' + 80' + 80') + 2(30')) x 18 x 1.5' thick/27
At-grade Slab with Beams	400	cy	200	600	$320,000	7200 sf x 1.5' thick/27
Superstructure						
Pump Room	1800	sf			$270,000	30' x 60'
Sodium Hypochlorite Room	600	ls			$150,000	20' x 30'
Polyphosphate Room	375	sf			$56,250	15' x 25'
Fluoride Room	375	sf			$56,250	15' x 25'
Electrical Room	800	sf			$120,000	20' x 40'
Generator Room		sf				(Keep generator in existing structure.)
HVAC Room	750	sf			$112,500	25' x 30'
Stairwells	600	sf			$90,000	2 @ 10' x 30'
Hallways	1200	sf			$180,000	10' x 120'
Control Room	300	sf			$45,000	15' x 20'
Lavatory	0	sf			$0	(Not required if station is to be un-manned.)
Site Work						
Pavement	2200	sy	12	8	$44,000	
Sidewalk	1200	sf	2	3	$6,000	

ELKHART, INDIANA
PUBLIC WORKS & UTILITIES

North Main Street Pumping Station Evaluation
Opinion of Probable Construction Cost
New Chemical Building

Greeley and Hansen
September, 2005

Description	*Quanity*	*Unit*	*Equipment Cost*	*Labor Cost*	*Total Cost*	*Notes*
Demolition						
Existing Chlorine Facilities	1	ls			$1,000	
Existing Fluoride Facilities	1	ls			$1,000	
Existing Polyphosphate Facilities	1	ls			$500	
Existing Electrical Facilities	1	ls			$1,000	
Yard Piping & Valves					$15,000	
Instrumentation & Controls		ls			$200,000	
Subtotal					$2,900,000	
Contingency @ 15%					$435,000	
Engineering & Administration @ 20%					$667,000	
Total (Rounded)					**$4,000,000**	

ELKHART, INDIANA
PUBLIC WORKS & UTILITIES

North Main Street Pumping Station Evaluation
Technical Memorandum

Essential Valve Replacement – Alternative A
Preliminary Sequence

Step A1 – (By EPW&U Personnel) Completely remove and scrap the valve controls and control console located in the Pump Room.

Step A2 – (By EPW&U Personnel) Completely remove and scrap all of the hydraulic control piping in the lower level of the Pumping Station. (Also remove any miscellaneous debris.)

Step A3 - (By EPW&U Personnel) Completely remove and scrap the horizontal tanks from the lower level of the Pumping Station.

Step A4 – (By EPW&U Personnel) Confirm that the buried discharge valves on the East Discharge Line (DL-East DIV North and DL-East DIV South) can be reliably actuated to isolate the Pumping Station from the distribution system. Service, repair or replace the valves if necessary. (Obtain outside assistance if needed.)

Step A5 – (By EPW&U Personnel) Confirm that HSP-2 Suction Adjustment Valves and the 8" Discharge Header Discharge Isolation Valve are operational.

Step A6 - (By Contractor) Sequentially replace all corroded exposed nuts and bolts as needed throughout the lower level to insure the pipe connections do not fail during subsequent construction operations.

Step A7 – (By Contractor) Remove the concrete below SH–SIV West as needed to remove and replace the valve.

Step A8 – (By EPW&U Personnel) Schedule and shut down the Pumping Station. (By Contractor) Quickly remove and replace SH-SIV West. Remove and replace the HSP-2 SAV valves at the same time if they are not operable.

Step A9 – (By EPW&U Personnel) Place the Pumping Station back in operation.

Step A10 – (By Contractor) With the new SH-SIV West and HSP-2 SAV Central closed, and operating off of the west suction line with HSP-2 and HSP-6, close the buried discharge valves (DL-East DIV North and DL-East DIV South) as needed to isolate the Discharge Line–East.

Step A11 – (By Contractor) Remove and replace HSP-5's suction and discharge valves (HSP-5 SIV, HSP-5 DCV & HSP-5 DIV).

Step A12 – (By EPW&U Personnel) Open the discharge line isolation valves (DL-East DIV North and DL-East DIV South) to place the DL- East back into service.

Step A13 - (By EPW&U Personnel) With the new SH-SIV East and HSP-4 SAV East valves closed and while operating off of the east suction line with HSP-4 and HSP-5, close DL-Central DIV East, DL-West & Central DIV West and DL-West & Central DIV East. (By Contractor) Remove and replace the 8" DH-DIV.

Step A 14 - (By EPW&U Personnel) Open all closed valves and place the Pumping Station into normal operation.

ELKHART, INDIANA
PUBLIC WORKS & UTILITIES

North Main Street Pumping Station Evaluation
Technical Memorandum

Secondary Valve Replacement – Alternative B
Preliminary Sequence

Step B1 – (By EPW&U Personnel) Remove and scrap the valve controls and control console located in the Pump Room.

Step B2 – (By EPW&U Personnel) Remove and scrap all of the hydraulic control piping in the lower level of the Pumping Station. (Also remove any miscellaneous debris.)

Step B3 - (By EPW&U Personnel) Remove and scrap the horizontal tanks from the lower level of the Pumping Station.

Step B4 – (By EPW&U Personnel) Confirm that the buried discharge valves on the East Discharge Line (DL-EAST DIV North and DL-East DIV South) can be reliably actuated to isolate the Pumping Station from the distribution system. Service, repair or replace the valves if necessary. (Obtain outside assistance if needed.)

Step B5 – (By EPW&U Personnel) Confirm that HSP-2 and HSP-4 Suction Adjustment Valves and the 8" Discharge Header Discharge Isolation Valve are operational.

Step B6 - (By Contractor) Sequentially replace all corroded exposed nuts and bolts as needed throughout the lower level to insure the pipe connections do not fail during subsequent construction operations.

Step B7 – (By Contractor) Remove the concrete below SH–SIV East, SH-SIV West, HSP-2 SAV West, HSP-2 SAV Center, HSP-4 SAV Center, HSP-4 SAV East, and the 8" DH-DIV as needed to remove and replace the valves.

Step B8 – (By EPW&U Personnel) Schedule and shut down the Pumping Station. (By Contractor) Quickly remove the SH-SIV West and install a blind flange on the west connection flange. Remove and replace the HSP-2 SAV valves at the same time if they are not operable.

Step B9 – (By EPW&U Personnel) Place the Pumping Station back in operation.

Step B10 – (By Contractor) With the HSP-2 SAV Central closed, and operating off of the west suction line with HSP-2 and HSP-6, remove and replace SH-SIV EAST.

Remove and replace the HSP-4 SAV valves at the same time if they are not operable.

Step B11 - (By Contractor) With SH-SIV East and HSP-4 SAV Center closed, and operating off of the east suction line with HSP-4 and HSP-5, remove the blind flange installed in Step B8 and install a new SH-SIV West.

Step B12 - (By EPW&U Personnel) Open the new SH-SIV West and HSP-4 SAV Center valves. Close the new SH-SIV East and HSP-4 SAV East valves, and while operating off of the west and central suction lines with HSP-2, HSP-3, HSP-4 and HSP-6, close the discharge valves (DL-EAST DIV North and DL-East DIV South) as needed to isolate the Discharge Line – East.

Step B13 – (By Contractor) Remove and replace HSP-5's suction and discharge valves (HSP-5 SIV, HSP-5 DCV & HSP-5 DIV). (Optional - Remove and replace with a spool DL-DIV East. Hard pipe or provide thrust restraint.)

Step B14 – (By EPW&U Personnel) Open the discharge line isolation valves (DL-East DIV North and DL-East DIV South) to place the DL-East back into service.

Step B15 - (By EPW&U Personnel) With the new SH-SIV East and HSP-4 SAV East valves closed and while operating off of the east suction line with HSP-4 and HSP-5, close DL-Central DIV East, DL-West & Central DIV West and DL-West & Central DIV East. (By Contractor) Remove and replace the 8" DH-DIV.

Step B 16 - (By EPW&U Personnel) Open all closed valves and place the Pumping Station into normal operation.

Project: Budgetary 2007 Projects -- Secondary Computer Upgrade + InTouch Version Upgrade(s)
Customer: Elkhart Public Works & Utilities
For: Bill Blowers
Project #: 2715
By: Integrated Telecommunication Systems, Inc.
Date: 11/10/2006

Type	Product	Sell Total
M	Motorola	$0.00
H	Hardware	$3,800.00
S	Software	$8,750.00
L	Labor (in house)	$2,000.00
T	Trips (on site)	$3,000.00
	Subtotal	$17,550.00
F	Freight (budgetary - see notes)	$0.00
	Total	$17,550.00

Notes:

Quotation Life - This quotation is for **BUDGETARY** purposes only. Please contact Robert McMahon at (847)368-8400 to validate hardware, software and serivces.
Installation Notes - This quotation does **NOT** include and installation services for MOSCAD equipment.
Payment Terms (35/45/20) - 35% of the project total will be due immediately or NET zero (0) with receipt of customer purchase order or contract. 45% of the project total will be due NET thirty (30) upon shipment of hardware & software. Final payment or 20% will be due NET thirty (30) upon project completion. These terms are subjection to discussion. Interest may be applied to delinquent or outstanding balances at a rate of 1-1/2% per month. Payment to ITS, Inc. is not subject to payment of money by 3rd party or others.
Payment Terms (35/65) - 35% of the project total will be due immediately or NET zero (0) with receipt of customer purchase order or contract. Final payment or 65% will be due NET thirty (30) upon shipment of hardware or software (project completion). These terms are subjection to discussion. Interest may be applied to delinquent or outstanding balances at a rate of 1-1/2% per month. Payment to ITS, Inc. is not subject to payment of money by 3rd party or others.
Radio Frequency Operation - MOSCAD System Owner shall be responsible for RF system design and operation. ITS, Inc is nor responsible for the Rf system design and operation. Upon ordering Motorola MOSCAD Hardware, correct frequencies to be programmed to each radio should be included on signed cover page or purchase order.
Hardware notes - All equipment becomes property of customer upon shipment.
Shipping - Unless specified otherwise [purchase order] standard shipping method will be FedEx ground service. Freight pricing is budgetary. Freight pricing will be prepaid and applied to the final invoice.

Customer Sign-Off: ______________________________
Print Name

____
Customer Signature

APPENDIX B

The Customer MUST sign and fax (847-368-0270) a copy of this front page to Integrated Telecommunication Systems confirming agreement with the terms and conditions defined in this proposal.

Customer Initials: _____

Design and engineering information contained in this proposal may not be shared with any person or agency not directly associated with the addressee without the express written consent of Integrated Telecommunication Systems Inc.

Project #: 2715
By: Integrated Telecommunication Systems, Inc.
Date: 11/10/2006

MOSCAD - MOtorola SCADA / Fixed Data Solutions - ITS is a Motorola Certified MOSCAD Solution Provider & Wonderware Certified System Integrator

Secondary Computer Upgrade

Item	Qty	Qty/@	Model	Type	Description	Price	Price Ext
1	1	1	CEN-COMP	H	Secondary SCADA Computer	$2,800.00	$2,800.00
2	1	1	SUA2200	H	UPS	$1,000.00	$1,000.00
3	1	1	CEN-CFG_Secondary	L	Computer Configuration - Configure OS, Load/Configure Wonderware's MODBUS I/O Server, Load/Configure Wonderare's InTouch, Load/Configure TeleDAC's Win911	$1,000.00	$1,000.00
4	1	1	ITS-SUP04	L	Technical Support - Up to 4 hours telephone support	$500.00	$500.00
	1				**Subtotal**		**$5,300.00**

InTouch Version Upgrade(s)

Item	Qty	Qty/@	Model	Type	Description	Price	Price Ext
5	1	1	12-9035	S	Version Upgrade, InTouch Development, 60K Tag, V9.5	$5,700.00	$5,700.00
6	1	1	12-10039	S	Version Upgrade, InTouch, Runtime, 60K Tag with I/O, V9.0	$2,800.00	$2,800.00
7	1	1	10529224	S	Symantec pcAnywhere Host & Remote - (v. 12.0)	$250.00	$250.00
8	1	1	ITS-ONSITE02	T	Onsite Engineering Services - Up to two (2) days onsite	$3,000.00	$3,000.00
9	1	1	ITS-SUP04	L	Technical Support - Up to 4 hours telephone support	$500.00	$500.00
	1				**Subtotal**		**$12,250.00**

Customer Initials: _____

Hubbard Ave. Revitalization - Water Main Replacement

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNITS	UNIT COST		TOTAL COST
101.1	Survey	1	L.S.	$ 35,000.00	=	$ 35,000.00
102.1	Clearing and Grubbing R.O.W.	1	L.S.	$ 75,000.00	=	$ 75,000.00
201.1	8" P.V.C. Sanitary Sewer	3000	L.F.	$ 55.00	=	$ 165,000.00
201.2	6" P.V.C. Sanitary Sewer Lateral	3750	L.F.	$ 45.00	=	$ 168,750.00
201.3	8" X 6" Tee Connections	125	EA.	$ 200.00	=	$ 25,000.00
201.4	Lateral Cleanout	125	EA.	$ 250.00	=	$ 31,250.00
201.5	Metal Casting for Cleanout	25	EA.	$ 300.00	=	$ 7,500.00
205.1	24" R.C.P. Storm Sewer	1250	L.F.	$ 90.00	=	$ 112,500.00
205.2	18" R.C.P. Storm Sewer	1150	L.F.	$ 70.00	=	$ 80,500.00
205.3	15" R.C.P. Storm Sewer	1000	L.F.	$ 55.00	=	$ 55,000.00
205.4	12" R.C.P. Storm Sewer	1000	L.F.	$ 45.00	=	$ 45,000.00
301.1	Sanitary Sewer Manholes	10	EA.	$ 2,750.00	=	$ 27,500.00
301.3	Storm Sewer Manholes	12	EA.	$ 2,750.00	=	$ 33,000.00
302.1	Storm Sewer Catch Basins	30	EA.	$ 2,000.00	=	$ 60,000.00
404.1	Pavement Removal & Grading	1	L.S.	$ 300,000.00	=	$ 300,000.00
401.1	4" HAC. Base #5D	16500	SY.	$ 11.00	=	$ 181,500.00
402.1	2" HAC Binder #8	16500	SY.	$ 5.50	=	$ 90,750.00
403.1	1 1/2" HAC Surface #11	16500	SY.	$ 5.00	=	$ 82,500.00
500.1	Concrete Drive Replacement	1200	S.Y.	$ 55.00	=	$ 66,000.00
601.1	Concrete Sidewalk	5500	S.Y.	$ 35.00	=	$ 192,500.00
603.1	Concrete Curb and Gutter	10000	L.F.	$ 16.00	=	$ 160,000.00
800.1	Landscape Restoration	1	L.S.	$ 85,000.00	=	$ 85,000.00
901.1	8" D.I. Water Main	2800	L.F.	$ 45.00	=	$ 126,000.00
902.1	D.I. Fittings	15	EA.	$ 1,500.00	=	$ 22,500.00
903.1	8" Gate Valve and Box	8	EA.	$ 1,500.00	=	$ 12,000.00
907.1	Fire Hydrant Assembly	7	EA.	$ 5,000.00	=	$ 35,000.00
909.1	Water Services	100	EA.	$ 1,000.00	=	$ 100,000.00
TOTAL PROJECT BID:						$ 2,374,750.00
803.0	Parks- PWU Supplies & Parks Installs Trees	150	EA.	$ 350.00	=	$ 52,500.00
TOTAL						**$ 2,427,250.00**
TOTAL SANITARY SEWER BID w/ 5% Contingency						**$ 446,250.00**
TOTAL STORM SEWER BID w/ 5% Contingency						**$ 405,300.00**
TOTAL STREET BID w/ 5% Contingency						**$ 1,386,787.50**
TOTAL WATER SEWER BID w/ 5% Contingency						**$ 310,275.00**
TOTAL PROJECT BID w/ 5% Contingency						**$ 2,548,612.50**

APPENDIX C

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNITS	UNIT COST		TOTAL COST
Hudson St. - Water Main Replacement						
Hudson Street from Bridge Street to South Shore, Fremont from Hudson to 1/2 block north of Hester, Hester from Fremont to Union Street						
101.1	Survey	1	L.S.	$ 50,000.00	=	$ 50,000.00
102.1	Clearing and Grubbing R.O.W.	1	L.S.	$ 75,000.00	=	$ 75,000.00
201.1	8" P.V.C. Sanitary Sewer	850	L.F.	$ 55.00	=	$ 46,750.00
201.2	6" P.V.C. Sanitary Sewer Lateral	3200	L.F.	$ 45.00	=	$ 144,000.00
201.4	8" X 6" Tee Connections	125	EA.	$ 200.00	=	$ 25,000.00
201.5	Lateral Cleanout	125	EA.	$ 250.00	=	$ 31,250.00
201.6	Metal Casting for Cleanout	25	EA.	$ 300.00	=	$ 7,500.00
205.4	15" R.C.P. Storm Sewer	1000	L.F.	$ 55.00	=	$ 55,000.00
205.5	12" R.C.P. Storm Sewer	950	L.F.	$ 45.00	=	$ 42,750.00
301.1	Sanitary Sewer Manholes	7	EA.	$ 2,750.00	=	$ 19,250.00
301.3	Storm Sewer Manholes	10	EA.	$ 2,750.00	=	$ 27,500.00
302.1	Storm Sewer Catch Basins	36	EA.	$ 2,000.00	=	$ 72,000.00
404.1	Pavement Removal & Grading	1	L.S.	$ 350,000.00	=	$ 350,000.00
401.1.	4" HAC. Base #5D	14500	SY.	$ 11.00	=	$ 159,500.00
402.1	2" HAC Binder #8	13500	SY.	$ 5.50	=	$ 74,250.00
403.1	1 1/2" HAC Surface #11	13500	SY.	$ 5.00	=	$ 67,500.00
500.1	Concrete Drive Replacement	500	S.Y.	$ 55.00	=	$ 27,500.00
601.1	Concrete Sidewalk	500	S.Y.	$ 35.00	=	$ 17,500.00
603.1	Concrete Curb and Gutter	9500	L.F.	$ 16.00	=	$ 152,000.00
800.1	Landscape Restoration	1	L.S.	$ 85,000.00	=	$ 85,000.00
901.1	8" D.I. Water Main	4775	L.F.	$ 50.00	=	$ 238,750.00
902.1	D.I. Fittings	25	EA.	$ 1,200.00	=	$ 30,000.00
903.1	8" Gate Valve and Box	20	EA.	$ 1,200.00	=	$ 24,000.00
907.1	Fire Hydrant Assembly	9	EA.	$ 5,000.00	=	$ 45,000.00
909.1	Water Services	85	EA.	$ 1,000.00	=	$ 85,000.00
TOTAL PROJECT BID:						$ 1,952,000.00
803.0	Parks- PWU Supplies & Parks Installs Tree:	100	EA.	$ 300.00	=	$ 30,000.00
TOTAL						**$ 1,982,000.00**
TOTAL SANITARY SEWER BID w/ 5% Contingency						**$ 287,437.50**
TOTAL STORM SEWER BID w/ 5% Contingency						**$ 207,112.50**
TOTAL STREET BID w/ 5% Contingency						**$ 1,142,662.50**
TOTAL WATER BID w/ 5% Contingency						**$ 443,887.50**
TOTAL PROJECT BID w/ 5% Contingency						**$ 2,081,100.00**

Beardsley Ave. Revitalization - Water Main Replacement

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNITS	UNIT COST		TOTAL COST
101.1	Survey	1	L.S.	$ 20,000.00	=	$ 20,000.00
102.1	Clearing and Grubbing R.O.W.	1	L.S.	$ 15,000.00	=	$ 15,000.00
201.1	12" P.V.C. Sanitary Sewer	1700	L.F.	$ 75.00	=	$ 127,500.00
201.2	8" P.V.C. Sanitary Sewer	1250	L.F.	$ 55.00	=	$ 68,750.00
201.3	6" P.V.C. Sanitary Sewer Lateral	1500	L.F.	$ 45.00	=	$ 67,500.00
201.4	12" X 6" Tee Connections	35	EA.	$ 300.00	=	$ 10,500.00
201.5	8" X 6" Tee Connections	15	EA.	$ 200.00	=	$ 3,000.00
201.6	Lateral Cleanout	50	EA.	$ 250.00	=	$ 12,500.00
201.7	Metal Casting for Cleanout	10	EA.	$ 300.00	=	$ 3,000.00
205.1	24" R.C.P. Storm Sewer	1350	L.F.	$ 90.00	=	$ 121,500.00
205.3	15" R.C.P. Storm Sewer	100	L.F.	$ 55.00	=	$ 5,500.00
205.4	12" R.C.P. Storm Sewer	700	L.F.	$ 45.00	=	$ 31,500.00
301.1	Sanitary Sewer Manholes	11	EA.	$ 2,750.00	=	$ 30,250.00
301.3	Storm Sewer Manholes	5	EA.	$ 2,000.00	=	$ 10,000.00
302.1	Storm Sewer Catch Basins	15	EA.	$ 1,700.00	=	$ 25,500.00
303.1	Storm Sewer Inlets	0	EA.	$ 1,350.00	=	$ -
404.1	Pavement Removal & Grading	1	L.S.	$ 400,000.00	=	$ 400,000.00
401.1	4" HAC. Base #5D	29000	SY.	$ 22.00	=	$ 638,000.00
402.1	2" HAC Binder #8	13500	SY.	$ 5.50	=	$ 74,250.00
403.1	1 1/2" HAC Surface #11	14250	SY.	$ 5.00	=	$ 71,250.00
500.1	Concrete Drive Replacement	750	S.Y.	$ 55.00	=	$ 41,250.00
601.1	Concrete Sidewalk	4500	S.Y.	$ 35.00	=	$ 157,500.00
603.1	Concrete Curb and Gutter	8000	L.F.	$ 16.00	=	$ 128,000.00
800.1	Landscape Restoration	1	L.S.	$ 125,000.00	=	$ 125,000.00
901.1	12" D.I. Water Main	3000	L.F.	$ 65.00	=	$ 195,000.00
901.3	6" D.I. Water Main	75	L.F.	$ 45.00	=	$ 3,375.00
902.1	D.I. Fittings	20	EA.	$ 1,750.00	=	$ 35,000.00
903.1	12" Gate Valve and Box	8	EA.	$ 3,000.00	=	$ 24,000.00
907.1	Fire Hydrant Assembly	6	EA.	$ 5,000.00	=	$ 30,000.00
909.1	Water Services	50	EA.	$ 1,100.00	=	$ 55,000.00
TOTAL PROJECT BID:						$ 2,529,625.00
803.0	Parks- PWU Supplies & Parks Installs Trees	60	EA.	$ 250.00	=	$ 15,000.00
TOTAL						**$ 2,544,625.00**
TOTAL SANITARY SEWER BID w/ 5% Contingency						**$ 339,150.00**
TOTAL STORM SEWER BID w/ 5% Contingency						**$ 203,700.00**
TOTAL STREET SEWER BID w/ 5% Contingency						**$ 1,769,512.50**
TOTAL WATER SEWER BID w/ 5% Contingency						**$ 359,493.75**
TOTAL PROJECT BID w/ 5% Contingency						**$ 2,671,856.25**

Crawford St. Revitalization - Water Main Replacement

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNITS	UNIT COST			TOTAL COST
101.1	Survey	1	L.S.	$ 30,000.00	=	$	30,000.00
102.1	Clearing and Grubbing R.O.W.	1	L.S.	$ 75,000.00	=	$	75,000.00
201.1	8" P.V.C. Sanitary Sewer	2510	L.F.	$ 55.00	=	$	138,050.00
201.2	6" P.V.C. Sanitary Sewer Lateral	3170	L.F.	$ 45.00	=	$	142,650.00
201.3	30" X 6" Tee Connections	31	EA.	$ 500.00	=	$	15,500.00
201.4	8" X 6" Tee Connections	82	EA.	$ 200.00	=	$	16,400.00
201.5	Lateral Cleanout	113	EA.	$ 250.00	=	$	28,250.00
201.6	Metal Casting for Cleanout	25	EA.	$ 300.00	=	$	7,500.00
205.1	30" R.C.P. Sanitary Sewer	1720	L.F.	$ 200.00	=	$	344,000.00
205.2	24" R.C.P. Storm Sewer	500	L.F.	$ 90.00	=	$	45,000.00
205.3	18" R.C.P. Storm Sewer	600	L.F.	$ 70.00	=	$	42,000.00
205.4	15" R.C.P. Storm Sewer	500	L.F.	$ 55.00	=	$	27,500.00
205.5	12" R.C.P. Storm Sewer	2650	L.F.	$ 45.00	=	$	119,250.00
301.1	Sanitary Sewer Manholes (4' Dia.)	6	EA.	$ 2,750.00	=	$	16,500.00
301.2	Sanitary Sewer (>4' Dia.)	9	EA.	$ 3,500.00	=	$	31,500.00
301.3	Storm Sewer Manholes	12	EA.	$ 2,750.00	=	$	33,000.00
302.1	Storm Sewer Catch Basins	35	EA.	$ 2,000.00	=	$	70,000.00
404.1	Pavement Removal & Grading	1	L.S.	$ 350,000.00	=	$	350,000.00
401.1	4" HAC. Base #5D	11850	SY.	$ 11.00	=	$	130,350.00
401.2	8" HAC. Base #5D	4750	SY.	$ 22.00	=	$	104,500.00
402.1	2" HAC Binder #8	16600	SY.	$ 5.50	=	$	91,300.00
403.1	1 1/2" HAC Surface #11	16600	SY.	$ 5.00	=	$	83,000.00
500.1	Concrete Drive Replacement	1500	S.Y.	$ 55.00	=	$	82,500.00
601.1	Concrete Sidewalk	4500	S.Y.	$ 35.00	=	$	157,500.00
603.1	Concrete Curb and Gutter	7500	L.F.	$ 16.00	=	$	120,000.00
800.1	Landscape Restoration	1	L.S.	$ 100,000.00	=	$	100,000.00
901.2	10" D.I. Water Main	950	L.F.	$ 57.50	=	$	54,625.00
901.3	8" D.I. Water Main	2100	L.F.	$ 50.00	=	$	105,000.00
902.1	D.I. Fittings	20	EA.	$ 1,350.00	=	$	27,000.00
903.2	10" Gate Valve and Box	2	EA.	$ 1,700.00	=	$	3,400.00
903.3	8" Gate Valve and Box	8	EA.	$ 1,200.00	=	$	9,600.00
907.1	Fire Hydrant Assembly	8	EA.	$ 5,000.00	=	$	40,000.00
909.1	Water Services	75	EA.	$ 1,000.00	=	$	75,000.00
TOTAL PROJECT BID:						$	2,715,875.00
803.0	Parks- PWU Supplies & Parks Installs Trees	100	EA.	$ 300.00	=	$	30,000.00
TOTAL						**$**	**2,745,875.00**
TOTAL SANITARY SEWER BID w/ 5% Contingency						**$**	**777,367.50**
TOTAL STORM SEWER BID w/ 5% Contingency						**$**	**353,587.50**
TOTAL STREET BID w/ 5% Contingency						**$**	**1,421,857.50**
TOTAL WATER BID w/ 5% Contingency						**$**	**330,356.25**
TOTAL PROJECT BID w/ 5% Contingency						**$**	**2,883,168.75**

Johnson St. Widening - New 20" Water Main

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNITS	UNIT COST		TOTAL COST
101.1	Survey/Mobilization/Demobilization	1	L.S.	$ 100,000.00	=	$ 100,000.00
201.1	10" P.V.C. Sanitary Sewer	1402	L.F.	$ 55.00	=	$ 77,110.00
201.2	8" P.V.C. Sanitary Sewer	2128	L.F.	$ 45.00	=	$ 95,760.00
201.3	6" P.V.C. Sanitary Sewer Lateral	2520	L.F.	$ 37.50	=	$ 94,500.00
201.4	10" X 6" P.V.C. Tee Connections	30	EA.	$ 300.00	=	$ 9,000.00
201.5	8" X 6" P.V.C. Tee Connections	33	EA.	$ 200.00	=	$ 6,600.00
206.1	12" V.C.P. Sanitary Sewer	3483	L.F.	$ 75.00	=	$ 261,225.00
206.2	8" V.C.P. Sanitary Sewer	360	L.F.	$ 55.00	=	$ 19,800.00
206.3	6" V.C.P. Sanitary Sewer Lateral	2000	L.F.	$ 42.50	=	$ 85,000.00
206.4	12" X 6" V.C.P. Tee Connections	50	EA.	$ 200.00	=	$ 10,000.00
301.1	Sanitary Sewer Manholes	20	EA.	$ 3,750.00	=	$ 75,000.00
901.1	20" D.I. Water Main	2000	L.F.	$ 150.00	=	$ 300,000.00
901.2	16" D.I. Water Main	110	L.F.	$ 110.00	=	$ 12,100.00
901.3	12" D.I. Water Main	300	L.F.	$ 65.00	=	$ 19,500.00
901.4	10" D.I. Water Main	50	L.F.	$ 57.50	=	$ 2,875.00
902.1	D.I. Fittings	12	EA.	$ 3,500.00	=	$ 42,000.00
903.1	24" Butterfly Valve	2	EA.	$ 6,000.00	=	$ 12,000.00
903.1	16" Butterfly Valve	2	EA.	$ 4,000.00	=	$ 8,000.00
903.2	12" Gate Valve and Box	2	EA.	$ 2,250.00	=	$ 4,500.00
903.2	10" Gate Valve and Box	2	EA.	$ 1,800.00	=	$ 3,600.00
903.3	8" Gate Valve and Box	3	EA.	$ 1,200.00	=	$ 3,600.00
909.1	Water Services	20	EA.	$ 1,400.00	=	$ 28,000.00

TOTAL PROJECT BID:	$ 1,270,170.00
TOTAL SANITARY SEWER BID w/ 5% Contingency	**$ 928,194.75**
TOTAL WATER BID w/ 5% Contingency	**$ 510,483.75**
TOTAL PROJECT BID w/ 5% Contingency	**$ 1,438,678.50**

Kilbourn Ave. Revitalization - Water Main Replacement

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNITS	UNIT COST		TOTAL COST
101.1	Survey	1	L.S.	$ 30,000.00	=	$ 30,000.00
102.1	Clearing and Grubbing R.O.W.	1	L.S.	$ 100,000.00	=	$ 100,000.00
201.1	8" P.V.C. Sanitary Sewer	4100	L.F.	$ 55.00	=	$ 225,500.00
201.2	6" P.V.C. Sanitary Sewer Lateral	4000	L.F.	$ 45.00	=	$ 180,000.00
201.3	24" X 6" Tee Connections	15	EA.	$ 500.00	=	$ 7,500.00
201.4	8" X 6" Tee Connections	120	EA.	$ 200.00	=	$ 24,000.00
201.5	Lateral Cleanout	120	EA.	$ 250.00	=	$ 30,000.00
201.6	Metal Casting for Cleanout	25	EA.	$ 300.00	=	$ 7,500.00
205.1	24" R.C.P. Sanitary Sewer	850	L.F.	$ 200.00	=	$ 170,000.00
205.2	24" R.C.P. Storm Sewer	450	L.F.	$ 90.00	=	$ 40,500.00
205.3	18" R.C.P. Storm Sewer	700	L.F.	$ 70.00	=	$ 49,000.00
205.4	15" R.C.P. Storm Sewer	1200	L.F.	$ 55.00	=	$ 66,000.00
205.5	12" R.C.P. Storm Sewer	4000	L.F.	$ 45.00	=	$ 180,000.00
301.1	Sanitary Sewer Manholes (4' Dia.)	14	EA.	$ 2,750.00	=	$ 38,500.00
301.2	Sanitary Sewer (>4' Dia.)	2	EA.	$ 3,500.00	=	$ 7,000.00
301.3	Storm Sewer Manholes	15	EA.	$ 2,750.00	=	$ 41,250.00
302.1	Storm Sewer Catch Basins	57	EA.	$ 2,000.00	=	$ 114,000.00
404.1	Pavement Removal & Grading	1	L.S.	$ 350,000.00	=	$ 350,000.00
401.1	4" HAC. Base #5D	17500	SY.	$ 11.00	=	$ 192,500.00
402.1	2" HAC Binder #8	17500	SY.	$ 5.50	=	$ 96,250.00
403.1	1 1/2" HAC Surface #11	17500	SY.	$ 5.00	=	$ 87,500.00
500.1	Concrete Drive Replacement	2250	S.Y.	$ 55.00	=	$ 123,750.00
601.1	Concrete Sidewalk	6000	S.Y.	$ 35.00	=	$ 210,000.00
603.1	Concrete Curb and Gutter	10500	L.F.	$ 16.00	=	$ 168,000.00
800.1	Landscape Restoration	1	L.S.	$ 100,000.00	=	$ 100,000.00
901.1	8" D.I. Water Main	5000	L.F.	$ 50.00	=	$ 250,000.00
902.1	D.I. Fittings	15	EA.	$ 1,200.00	=	$ 18,000.00
903.1	8" Gate Valve and Box	20	EA.	$ 1,200.00	=	$ 24,000.00
907.1	Fire Hydrant Assembly	7	EA.	$ 5,000.00	=	$ 35,000.00
909.1	Water Services	85	EA.	$ 1,000.00	=	$ 85,000.00

TOTAL PROJECT BID:						$ 3,050,750.00
803.0	Parks- PWU Supplies & Parks Installs Tree:	100	EA.	$ 300.00	=	$ 30,000.00
TOTAL						**$ 3,080,750.00**
TOTAL SANITARY SEWER BID w/ 5% Contingency						**$ 724,500.00**
TOTAL STORM SEWER BID w/ 5% Contingency						**$ 515,287.50**
TOTAL STREET BID w/ 5% Contingency						**$ 1,562,400.00**
TOTAL WATER BID w/ 5% Contingency						**$ 432,600.00**
TOTAL PROJECT BID w/ 5% Contingency						**$ 3,234,787.50**

FULTON STREET REVITALIZATION - WATER MAIN REPLACEMENT							
ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNITS	UNIT COST			TOTAL COST
101.1	Survey	1	L.S.	$ 75,000.00	=	$	75,000.00
102.1	Clearing and Grubbing R.O.W.	1	L.S.	$ 100,000.00	=	$	100,000.00
201.1	8" P.V.C. Sanitary Sewer	5700	L.F.	$ 55.00	=	$	313,500.00
201.2	6" P.V.C. Sanitary Sewer Lateral	6000	L.F.	$ 45.00	=	$	270,000.00
201.3	24" X 6" Tee Connections	20	EA.	$ 500.00	=	$	10,000.00
201.4	8" X 6" Tee Connections	140	EA.	$ 200.00	=	$	28,000.00
201.5	Lateral Cleanout	140	EA.	$ 250.00	=	$	35,000.00
201.6	Metal Casting for Cleanout	25	EA.	$ 300.00	=	$	7,500.00
205.1	24" R.C.P. Sanitary Sewer	850	L.F.	$ 200.00	=	$	170,000.00
205.2	24" R.C.P. Storm Sewer	100	L.F.	$ 90.00	=	$	9,000.00
205.3	18" R.C.P. Storm Sewer	2150	L.F.	$ 70.00	=	$	150,500.00
205.4	15" R.C.P. Storm Sewer	1200	L.F.	$ 55.00	=	$	66,000.00
205.5	12" R.C.P. Storm Sewer	3000	L.F.	$ 45.00	=	$	135,000.00
301.1	Sanitary Sewer Manholes (4' Dia.)	17	EA.	$ 2,750.00	=	$	46,750.00
301.2	Sanitary Sewer (>4' Dia.)	6	EA.	$ 6,000.00	=	$	36,000.00
301.3	Storm Sewer Manholes	15	EA.	$ 3,250.00	=	$	48,750.00
302.1	Storm Sewer Catch Basins	72	EA.	$ 2,000.00	=	$	144,000.00
404.1	Pavement Removal & Grading	1	L.S.	$ 350,000.00	=	$	350,000.00
401.1	4" HAC. Base #5D	24650	SY.	$ 11.00	=	$	271,150.00
402.1	2" HAC Binder #8	24000	SY.	$ 5.50	=	$	132,000.00
403.1	1 1/2" HAC Surface #11	24000	SY.	$ 5.00	=	$	120,000.00
500.1	Concrete Drive Replacement	4500	S.Y.	$ 55.00	=	$	247,500.00
601.1	Concrete Sidewalk	7750	S.Y.	$ 35.00	=	$	271,250.00
603.1	Concrete Curb and Gutter	14000	L.F.	$ 16.00	=	$	224,000.00
800.1	Landscape Restoration	1	L.S.	$ 100,000.00	=	$	100,000.00
901.1	8" D.I. Water Main	6500	L.F.	$ 50.00	=	$	325,000.00
902.1	D.I. Fittings	50	EA.	$ 1,500.00	=	$	75,000.00
903.1	8" Gate Valve and Box	20	EA.	$ 1,200.00	=	$	24,000.00
907.1	Fire Hydrant Assembly	12	EA.	$ 5,000.00	=	$	60,000.00
909.1	Water Services	125	EA.	$ 1,000.00	=	$	125,000.00
TOTAL PROJECT BID:						$	3,969,900.00
803.0	Parks- PWU Supplies & Parks Installs Tree	200	EA.	$ 300.00	=	$	60,000.00
TOTAL						**$**	**4,029,900.00**
TOTAL SANITARY SEWER BID w/ 5% Contingency						**$**	**962,587.50**
TOTAL STORM SEWER BID w/ 5% Contingency						**$**	**580,912.50**
TOTAL STREET BID w/ 5% Contingency						**$**	**2,048,445.00**
TOTAL WATER BID w/ 5% Contingency						**$**	**639,450.00**
TOTAL PROJECT BID w/ 5% Contingency						**$**	**4,231,395.00**

S. MICHIGAN ST. - WATER MAIN REPALCEMENT

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNITS	UNIT COST		TOTAL COST
101.1	Survey	1	L.S.	$ 75,000.00	=	$ 75,000.00
102.1	Clearing and Grubbing R.O.W.	1	L.S.	$ 100,000.00	=	$ 100,000.00
201.1	8" P.V.C. Sanitary Sewer	3500	L.F.	$ 55.00	=	$ 192,500.00
201.2	6" P.V.C. Sanitary Sewer Lateral	6000	L.F.	$ 45.00	=	$ 270,000.00
201.3	24" X 6" Tee Connections	27	EA.	$ 500.00	=	$ 13,500.00
201.4	8" X 6" Tee Connections	170	EA.	$ 200.00	=	$ 34,000.00
201.5	Lateral Cleanout	197	EA.	$ 250.00	=	$ 49,250.00
201.6	Metal Casting for Cleanout	25	EA.	$ 300.00	=	$ 7,500.00
205.3	18" R.C.P. Storm Sewer	850	L.F.	$ 70.00	=	$ 59,500.00
205.4	15" R.C.P. Storm Sewer	1325	L.F.	$ 55.00	=	$ 72,875.00
205.5	12" R.C.P. Storm Sewer	3150	L.F.	$ 45.00	=	$ 141,750.00
301.1	Sanitary Sewer Manholes (4' Dia.)	20	EA.	$ 2,750.00	=	$ 55,000.00
301.2	Sanitary Sewer (>4' Dia.)	3	EA.	$ 6,000.00	=	$ 18,000.00
301.3	Storm Sewer Manholes	15	EA.	$ 3,250.00	=	$ 48,750.00
302.1	Storm Sewer Catch Basins	36	EA.	$ 2,000.00	=	$ 72,000.00
404.1	Pavement Removal & Grading	1	L.S.	$ 400,000.00	=	$ 400,000.00
401.1	4" HAC. Base #5D	25000	SY.	$ 11.00	=	$ 275,000.00
402.1	2" HAC Binder #8	18000	SY.	$ 5.50	=	$ 99,000.00
403.1	1 1/2" HAC Surface #11	18000	SY.	$ 5.00	=	$ 90,000.00
500.1	Concrete Drive Replacement	3600	S.Y.	$ 55.00	=	$ 198,000.00
601.1	Concrete Sidewalk	3000	S.Y.	$ 35.00	=	$ 105,000.00
603.1	Concrete Curb and Gutter	10000	L.F.	$ 16.00	=	$ 160,000.00
800.1	Landscape Restoration	1	L.S.	$ 75,000.00	=	$ 75,000.00
901.1	12" D.I. Water Main	2000	L.F.	$ 70.00	=	$ 140,000.00
901.2	8" D.I. Water Main	3500	L.F.	$ 50.00	=	$ 175,000.00
902.1	D.I. Fittings	25	EA.	$ 1,500.00	=	$ 37,500.00
903.1	12" Gate Valve and Box	3	EA.	$ 2,200.00	=	$ 6,600.00
903.1	8" Gate Valve and Box	12	EA.	$ 1,200.00	=	$ 14,400.00
907.1	Fire Hydrant Assembly	15	EA.	$ 5,000.00	=	$ 75,000.00
909.1	Water Services	85	EA.	$ 1,000.00	=	$ 85,000.00

TOTAL PROJECT BID:						$ 3,145,125.00
803.0	Parks- PWU Supplies & Parks Installs Trees	200	EA.	$ 300.00	=	$ 60,000.00
TOTAL						**$ 3,205,125.00**
TOTAL SANITARY SEWER BID w/ 5% Contingency						**$ 671,737.50**
TOTAL STORM SEWER BID w/ 5% Contingency						**$ 414,618.75**
TOTAL STREET BID w/ 5% Contingency						**$ 1,718,850.00**
TOTAL WATER BID w/ 5% Contingency						**$ 413,175.00**
TOTAL PROJECT BID w/ 5% Contingency						**$ 3,218,381.25**

NORTHLAND
CORPORATION

December 4, 2006

Mr. Michael C. Machlan, P.E.
Board of Public Works
City of Elkhart
1201 South Nappanee St.
Elkhart, IN 46516

Re: Industrial Land Cost – Elkhart, IN

Dear Mr. Machlan,

The Northland Corporation has been developing industrial parks in Elkhart County since 1966. We are currently developing the 1,000 acre Elkhart East Business Community.

The current market conditions for industrial land are as follows:

- Pricing ranges from $30,000 - $65,000 per acre.
- $55,000 - $65,000 per acre for land with sewer, water, and fiber optic connectivity.
- $45,000 - $55,000 per acre for property in a park that is older than ten years but has sewer and water.
- $30,000 - $45,000 per acre for property in a park that is older than 10 years but does not have municipal sewer and water.

If you have any further questions please do not hesitate to contact me.

With Regards,

Robert E. Letherman, CCIM
Vice President
Northland Corporation

APPENDIX
D

December 4, 2006

Co-Director Office of Public Works
City of Elkhart
1201 S. Nappanee Street
Elkhart, IN 46516

Attn: Mike Machlan

RE: LAND ACQUISITION IN ELKHART, INDIANA

Dear Mr. Machlan:

Per your request for an estimated value of an acre of land located within Elkhart, Indiana, and with the location being non-prime real estate, I believe an estimated purchase price would be approximately **$32,500/acre**. This estimate was determined by a recent land acquisition done in the area of County Road 104 and County Road 6.

However, there are a few factors to take into consideration when trying to determine the estimated value of a parcel within Elkhart, Indiana. One primary factor would be the location of the parcel. It has been our experience that property located on the North and East sides of Elkhart is usually more expensive than property located on the South and West side of Elkhart.

We do suggest that before final negotiations with any property owner take place, an appraisal of the property should be completed. You could hire an appraiser with the property owner to save costs, or get your own appraisal and have the property owner get their own in order to compare them.

There are additional factors to consider when looking for a parcel in Elkhart, Indiana. Some of the areas you may choose for purchasing land may require additional expenses besides acquisition cost of the land. They could include the following: preliminary meetings and research, survey activities, deed preparation and title reports, property owner meetings and attorney fees.

WIGHTMAN PETRIE

Below I have charted out what we believe may be additional expenses needed in the land acquisition.

1.	*Preliminary Activities*	
	Meetings, Research, etc.	$ 700.00
2.	Survey Activities	
	Deed research, surveys, preliminary and final plats, legal description and exhibits.	$2,500.00
3.	Deed Preparation and Title Reports	
	Preliminary deeds (assumes 2) $500/each	$1,000.00
	Title Reports (assumes 2) $500/each	$1,000.00
	Meetings and Research	$1,000.00
4.	Property Owner Meetings	
	Meetings w/property owner (3 mtgs per owner)	$1,000.00
	Field staking of project (allowance)	$2,000.00

<u>Summary of Above Estimated Fees</u>:

Preliminary Activities:	$ 700.00
Surveying:	$2,500.00
Deed Preparation and Title Reports:	$3,000.00
Property Owner Meetings:	$3,000.00

TOTAL ESTIMATED ADDITIONAL FEES: $9,200.00

I hope the above information has been helpful in your research and cost analysis of additional property acquisition.

If you have any further questions, or we can be of further assistance, please do not hesitate to contact me.

Sincerely,

Jennifer Ransbottom mm.

Jennifer J. Ransbottom
Land Acquisition Specialist

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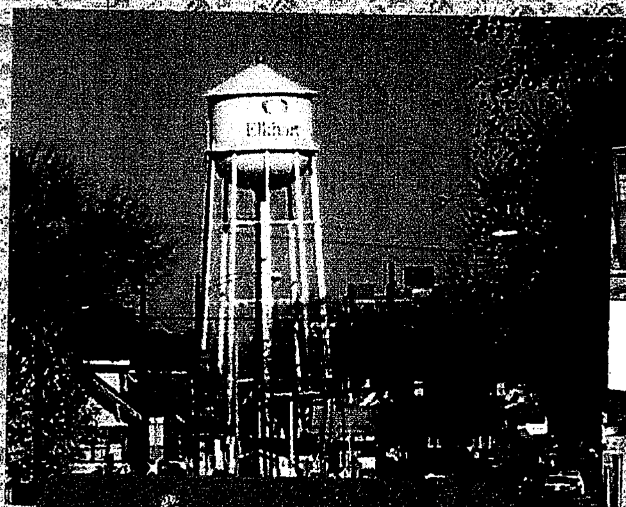
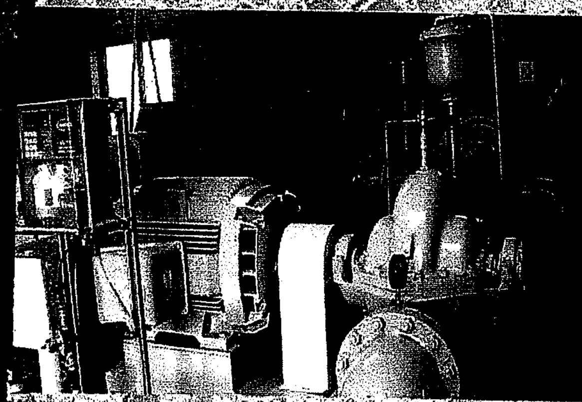
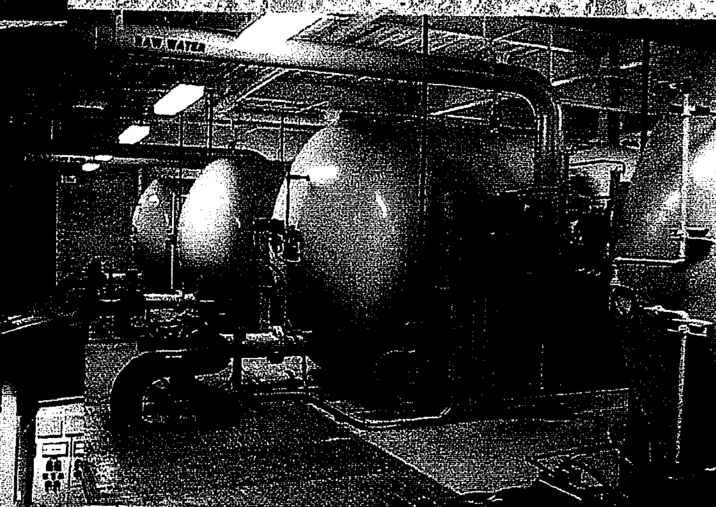
Master Plan for Water Supply & Distribution
2001 - 2015





City of Elkhart, Indiana
Public Works & Utilities



January 2002

Prepared by:
Malcolm Pirnie, Inc. Engineers
City of Elkhart Public Works & Utilities

ATTACHMENT
1

CITY OF ELKHART
MASTER PLAN FOR WATER SUPPLY AND DISTRIBUTION
DEPARTMENT OF PUBLIC WORKS & UTILITIES
JANUARY 2002

Table of Contents

1.0 PROJECT PURPOSE AND APPROACH

The purpose of the City of Elkhart's Water Master Plan is to identify the necessary capital improvements to ensure adequate water supply, storage, and distribution for the next fifteen years. Key analyses performed in developing the master plan include the following:

- Development of spatially allocated demands using customer billing data
- Modeling of the distribution system for the June 9th, 1999 max day event
- Development of future demands for the 2005 and 2015 planning years
- Modeling of supply and distribution system improvements to meet future demands
- Assessment of the expandability of Elkhart's existing well fields

2.0 EXISTING DISTRIBUTION SYSTEM

The City of Elkhart's water distribution system is made up of three groundwater sources, four elevated storage tanks, and a distribution network of approximately 327 miles of water mains serving an area of approximately 47 square miles. In recent years, the system has encountered challenges in attempting to meet maximum day demands, with the most recent max day event observed on June 9th, 1999.

2.1 *Water Supply*

Elkhart's most central source is the North Main Street Well Field, which has a firm capacity of 15.8 mgd. Development on the periphery of the city has shifted reliance from this well field to newer sources. The South Well Field has a firm capacity of 1.8 mgd and an iron removal capacity of 3.6 mgd. The South Well Field fills an important need of serving the growing areas in the south; the system demand on this well field is greater than its firm capacity. The newest well field is the Northwest Well Field. This well field has a firm capacity of 4.3 mgd and a capacity of 5.0 mgd at its treatment plant.

2.2 *Storage*

Elkhart currently has four elevated storage tanks dispersed throughout their system. The Benham, Bower Street, and South Well Field tanks are each 0.5 MG elevated steel tanks, while the Riverview Tank is a 1.0 MG elevated composite tank.

2.3 *Existing System Performance*

A map of the distribution system well fields, elevated storage units, and the modeled pressures for the June 9th, 1999 maximum day event are shown on Figure 2.1. The existing distribution system is currently able to meet system demands and maintain satisfactory pressures (primarily between 40 and 70 psi) in all areas other than the southern extremities of the system. The southern part of the distribution system (shown in yellow and orange) appears to have lower pressures due to its higher elevation and small transmission mains connecting it to the South Well Field. The City of Elkhart has planned to use booster pumps in all future development in this part of the system so that satisfactory water pressure is always maintained.

Under the 1999 maximum day conditions, the model predicted that the South Well Field is required to operate past its firm capacity and is close to its total capacity in meeting the existing demand. This model prediction was confirmed by the actual operational data from June 9th, 1999. Surpassing the firm capacity of a well field on a maximum day means that, in the event of a pump or motor failure in a well, the South Well Field could not meet system demands, and pressures on the south side of the system would be expected to drop.

3.0 EXISTING AND FUTURE WATER DEMANDS

The technical memorandum Water Supply Evaluation: Determination of Future Water Supply Needs (Malcolm Pirnie, 2000, Appendix A) outlined a land use-based demand projection using 1998 water usage rates for each major customer class and the proposed 2015 Urban Services Area presented in the Comprehensive Land Use Plan (Woolpert, 1996). For the purposes of the master planning, future maximum day demands were developed based on this approach for 2015, and 2005 future demands were developed assuming straight-line growth between 1999 and 2015. The projected maximum day demands are 20 mgd for 2005 and 27 mgd for 2015. A map of the development areas and the new demand polygons is shown on Figure 3.1.

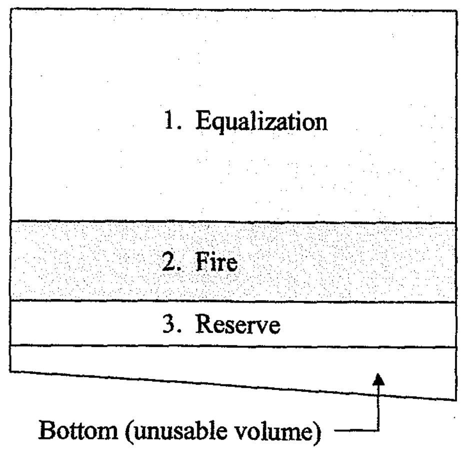
3.1 Demand Forecast

The City of Elkhart is anticipating growth in residential, commercial, and industrial properties on the periphery of the city within the 15 year planning period. The diurnal pattern for the existing 24-hour maximum day demand and the projected maximum day demand for the years 2005 and 2015 are plotted in Figure 3.2.

3.2 Storage Requirements

Accepted industry standards for treated water storage have generally been to accommodate each of the following three considerations: equalization of maximum-day water demands, fire flows, and emergency or contingency reserve (Planning and Managing Reliable Urban Water Systems, AWWA, 1997). These considerations are show in Figure 3.3.

Figure 3.3: Conceptual Allocation of Eleveated Storage



Equalization storage is the volume of water needed to meet all hourly demands above the 24-hour average on a maximum day, and is shown by the hatched area on Figure 3.2. The well fields and water treatment plants are sized to meet the average demand on the maximum day, and then the equalization storage provides the additional water needed to meet the peak hour. The equalization storage requirement for a maximum day event was determined from Elkhart's diurnal demand pattern. Storage projections are summarized for each planning period in Table 3.1.

TABLE 3.1

SUMMARY OF STORAGE PROJECTIONS

	1999	**2005**	**2015**
Equalization Storage	2.6	3.3	4.6
Fire Flow Storage	0.0	0.0	0.0
Reserve (10%)	0.3	0.3	0.5
Total Storage (MG)	2.9	3.6	5.1
Storage Deficiency (MG)*	**(0.4)**	**(1.1)**	**(2.6)**

*Based on available storage of 2.5 MG in 2001

Based on this analysis, the system is presently deficient in equalization storage and will require construction of a single elevated tank by 2005 with an additional one or two elevated tanks by 2015. Assuming standard increments for constructing elevated storage, a 1.0 MG is recommended for 2005, which would be the equivalent of having a 7% reserve in the system. By 2015, two additional tanks may be needed; the recommended capacity of each is 0.75 MG, which would be the equivalent of having an 8% reserve in the system. Storage is not being allocated for fire protection, because fire flow capacity can be more cost effectively built into the existing high service pumping stations at the well fields. Currently, cost-competitive methods of tank construction in the water industry are composites and steel ellipsoids.

4.0 FUTURE DISTRIBUTION SYSTEM CONDITIONS

The performance of the existing water system was evaluated under future demand conditions. Future maximum day demands, as well as maximum days with fires were modeled. Simultaneous 3-mgd and 1-mgd fires, each three hours in duration, were modeled beginning at 8:00 PM when the system storage should be at its lowest levels due to the continuous draining of all elevated tanks since the morning, as shown on Figure 3.2. The 3-mgd fire was modeled at the Elkhart General Hospital west of downtown and the 1-mgd fire on the east side of the city.

4.1 *Effects of Future Demand on the Existing System*

For the future demand conditions, all well fields were modeled as an infinite source. This approach allows water to reach the system from the well fields in the most energy efficient manner, while establishing the degree of reliance that the system places on each source. It also assumes that the high service pumping capacity does not limit the system. The modeled pressures for the existing system attempting to meet the projected 2005 demands are shown on Figure 4.1. The targeted range of operating pressures for Elkhart's system is 40 to 70 psi, with pressures reaching slightly above 80 psi near the North Main Street Well Field; these pressures are selected to maintain what was observed in the existing system. Although pressures are above 40 psi in all but the southern extremities of the system, the modeled delivery from the South Well Field exceeds its firm capacity. An expansion of the South Well Field would be advantageous from a distribution and energy use perspective. If the well field is expanded, expansion of South Well Field treatment facilities is likely not required, as its iron removal capacity is rated at 3.6 mgd.

The modeled pressures for the existing system attempting to meet the projected 2015 demands are shown on Figure 4.2. Under these demands, the east side of the distribution system displays low pressures (below 40 psi), and the Northwest and South Well Fields lack the firm capacity to meet the demand requirements on the perimeter of the city.

4.2 *Proposed Supply Expansion*

The technical memorandum <u>Water Supply Evaluation: Evaluation of Alternatives</u> (Malcolm Pirnie, 2000, Appendix A) outlined the current and feasible capacity for the three well fields, which is reported in Table 4.1. Planning for future expansions should match the firm capacity of the well fields with the average required inflow for a maximum day event; system storage will provide the additional inflow for the maximum hour.

TABLE 4.1 SUMMARY OF POTENTIAL TOTAL INCREASED WATER SUPPLY CAPACITY			
	Current Capacity (mgd)	**Feasible Capacity (mgd)**	**Potential Increase (mgd)**
Northwest Well Field	4.3	8.6	4.3
North Main St. Well Field	15	17	1.7
South Well Field	1.8	2.5	0.7
System Total	21	28	7.5

A proposed new system was modeled to establish realistic maximum well field capacities. For the 2005 planning year, expansions in supply at the South and Northwest Well Fields were modeled. For the 2015 planning year, because further expansion of the existing well fields is not feasible, a new well field was modeled at a location in the northeast quadrant of the service area. The performance goals for the modeling were to maintain the existing distribution system pressures and to operate the well fields within their feasible firm capacity as identified in Table 4.1.

4.2.1 *North Main Street Well Field*

The projected supply from the North Main Street Well Field for a series of maximum day event scenarios is shown in Figure 4.3. Although the well field is not operating near its present firm capacity, its distance from the anticipated development does not allow it to supply water to the east and south perimeters of the city without increasing downtown pressures above 100 psi. Therefore, expansion is not recommended for the North Main Street Well Field, and its planned production would remain approximately 11 to 12 mgd on a maximum day. However, the construction of booster pumps or additional transmission mains could allow for an expanded North Main Street Well Field to supply additional water to future developments.

4.2.2 *South Well Field*

The projected supply from the South Well Field for the same series of maximum day event scenarios is shown in Figure 4.4. The large inflow requirement from this well field is in part due to the proximity of the well field and the proposed developments on the south side of the city. An expansion in the South Well Field's firm capacity from 1.8 to 2.5 mgd is recommended as part of the 2005 planning year to meet the projected demands near the well field. Its planned production is approximately 1.9 to 2.3 mgd on a maximum day.

4.2.3 *Northwest Well Field*

The projected supply from the Northwest Well Field for the same series of maximum day event scenarios is shown in Figure 4.5. In the future, this well field will provide water to developments on the north side, as well as the south side, via transmission mains that loop the city. An expansion in the well field's firm capacity from 4.3 to 8.0[1] mgd is recommended to meet the projected 2005 and 2015 demands throughout the system. Its planned production is approximately 7.6 to 7.8 mgd on a maximum day. The Northwest Well Field has a treatment plant designed for iron and manganese removal; an expansion of the plant's capacity from 5.0 to 8.0 mgd is recommended.

4.2.4 *Future Northeast Well Field*

As described in the technical memorandum Water Supply Evaluation: Evaluation of Alternatives (Malcolm Pirnie, 2000, Appendix A), the three existing well fields have a feasible firm capacity of 28 mgd. The distribution system hydraulic model established that approximately 5 to 6 mgd from the North Main Street Well Field cannot be used to meet demands on the perimeter of the city with the current system configuration, leaving a feasible firm capacity of 22 to 23 mgd for the three well fields. This implies that, as a minimum, a new 5 to 6 mgd well field is needed to meet the future demand of 27 mgd for the planning year 2015. However, unrealized firm capacity at existing well fields and the lack of fire flow storage in the system imply that a well field with a firm capacity of 7.0 to 7.5 mgd is required.

The recommended 7.0 to 7.5 mgd well field includes:

- Unrealized potential firm capacity from the North Main Street Well Field (5 to 6 mgd). This capacity is considered unrealized because the distribution system is not currently configured to transport this additional water from the well field to the periphery of the system. Said another way, unrealized capacity is available water that cannot be moved from the source of supply to the location of the demand due to distribution system limitations.
- Unrealized potential firm capacity (approximately 1.5 mgd) from the South and Northwest Well Fields.

[1] An expansion to 8.0 mgd at the Northwest Well Field is sufficient to meet maximum day demands for 2005 and 2015; full expansion to the feasible firm capacity of 8.6 mgd is not recommended.

- Fire flow capacity for the distribution system (approximately 0.5 mgd).

The hydraulic model supported this recommendation of this new well field with an operating pressure of 55 psi in the northeast quadrant of the system.

Given the current economic downturn and the long-term planning period for the new Northeast Well Field, it is important to revisit this recommendation for a new well field in five to seven years. At that time, the following questions should be posed:

- Have the demand projections made in this 2001 study been realized? If not, is the needed capacity for the new Northeast Well Field reduced?
- What is the availability of the Bayer[2] wells as a supplemental water supply? Can the Bayer wells be used to reduce or eliminate the need for a new Northeast Well Field?
- Are there other alternatives for developing a new water supply or expanding the existing water supply that should be considered that weren't available in 2001 or that weren't evaluated in detail for this plan, such as a transmission line from the North Main Street Well Field to the east side as a cost-effective and reliable supply to meet growing demands in the east?

Once the re-evaluation of the proposed new well field has been completed, and the main and storage improvements have been revisited in 2006-2008, then the proposed improvements for 2015 can be refined, budgeted, and implemented.

4.3 *Projected Storage Upgrades*

To meet the equalization storage requirements presented in Table 3.1, under future conditions, elevated tanks were modeled on the east side of the system. Areas of the distribution system that experience low pressures during peak hours will benefit from immediate equalization storage. The criteria used to model these tanks are summarized in Table 4.2. A 1.0 MG elevated tank, proposed for 2005, will be replenished by the Northwest Well Fields and will provide equalization storage for the northeast portion of the system. The two 0.75 MG elevated tanks, proposed for 2015, will be replenished by the Northeast Well Field and will provide equalization storage for the south and southeast portions of the system.

[2] There are ongoing possiblities that a water supply at the Bayer property may become available to the City.

TABLE 4.2 PROPOSED NEW ELEVATED TANK CRITERIA			
Planning Year	**2005**	**2015**	**2015**
Model Element	T-5	T-6	T-7
D/S Junction	J-53	J-78	J-70
Height of Low Water Level (ft)	115	122	102
Volume (MG)	1.00	0.75	0.75

4.4 *Projected Distribution System Upgrades*

The City of Elkhart has planned several distribution system projects as part of their Capital Improvements Plan for the 2005 and 2015 planning years. All proposed pipes were modeled to evaluate their effectiveness in the system under 2005 and 2015 demands.

The modeled pressures for the proposed 2005 distribution system, with the 1 mgd and 3 mgd three-hour fires in the evening, are shown on Figure 4.6. The proposed improvements include upgrades at the Northwest and South Well Fields (as discussed in Sections 4.2.2 and 4.2.3), a 1.0 MG elevated tank in the northeast end of the system (as discussed in Section 4.3), and two of the planned water main improvements. The 24" river crossing along CR 6 and CR 7 is essential in allowing the Northwest Well Field to supply the east side of the system. Compared to Figure 4.1, which does not include improvements, system pressures are 5-10 psi higher on the north side. This increase in pressure is important because, as shown on Figure 4.1, the northeast quadrant of the system displayed pressures near the acceptable lower limit of 40 psi without the proposed improvements. The proposed improvements shown on Figure 4.6 enable Elkhart's water system to meet 2005 demands while maintaining acceptable pressures throughout the system.

The modeled pressures for the proposed 2015 distribution system, with the 1-mgd and 3-mgd three-hour fires in the evening, are shown on Figure 4.7. The proposed improvements include upgrades at the Northwest and South Well Fields, a new Northeast Well Field (as discussed in Sections 4.2.2, 4.2.3, and 4.2.4) with a firm capacity of 7.0 to 7.5 mgd, a 1.0 MG elevated tank in the northeast, a pair of 0.75 MG elevated tanks in the southeast (as discussed in Section 4.3) and all of the planned water main improvements. The new Northeast Well Field replenishes the 1.0 MG tank and maintains targeted pressures throughout the north side of the system. Compared to Figure 4.2, which does not include improvements, system pressures have been increased by as much as 30 psi on the east side, 5-10 psi on the south side, and 10-15 psi on the north side. This increase in pressure is important because, as shown on Figure 4.2, nearly a third of the system displayed pressures below 40 psi, which is unacceptable for effective delivery of water in Elkhart's system. The proposed improvements shown in Figure 4.7 will allow the distribution system to meet the projected 2015 demands and maintain acceptable pressures throughout the system.

4.5 *Capital Improvements*

The proposed distribution system, storage, supply, and treatment costs for the planning year 2005 and 2015 are summarized in Table 4.3 and Table 4.4, respectively. The estimated total cost for the improvements are $13 million in 2005 and $34 million in 2015. Both costs are in year 2001 dollars.

4.6 Planning Schedule

A schedule detailing the phases of work for expanding the Northwest Well Field and Water Treatment Plant and the South Well Field is proposed in Table 4.5. In order to have an upgraded treatment plant on-line and able to meet the forecasted demands for 2005, the City of Elkhart must begin the preliminary groundwater investigations in the next few months and the design of the water treatment plant expansion must begin in 2002.

TABLE 4.5

CITY OF ELKHART
PROPOSED SCHEDULE FOR NORTHWEST WELL FIELD AND SOUTH WELL FIELD IMPROVEMENTS

Effort	Timeframe
Part 1 Ground Water Desktop Evaluations	November – December 2001
Part 2 Ground Water Investigations – Exploration and Geologic Testing	January – April 2002 (or) May – August 2002
Part 3 Aquifer Hydraulic Testing	September – December 2002
Design of Northwest Well Field and Water Treatment Plant	September 2002 – May 2003
Advertise for Bid	May 2003 – July 2003
Construction of Well Field and Water Treatment Plant	July 2003 to December 2004

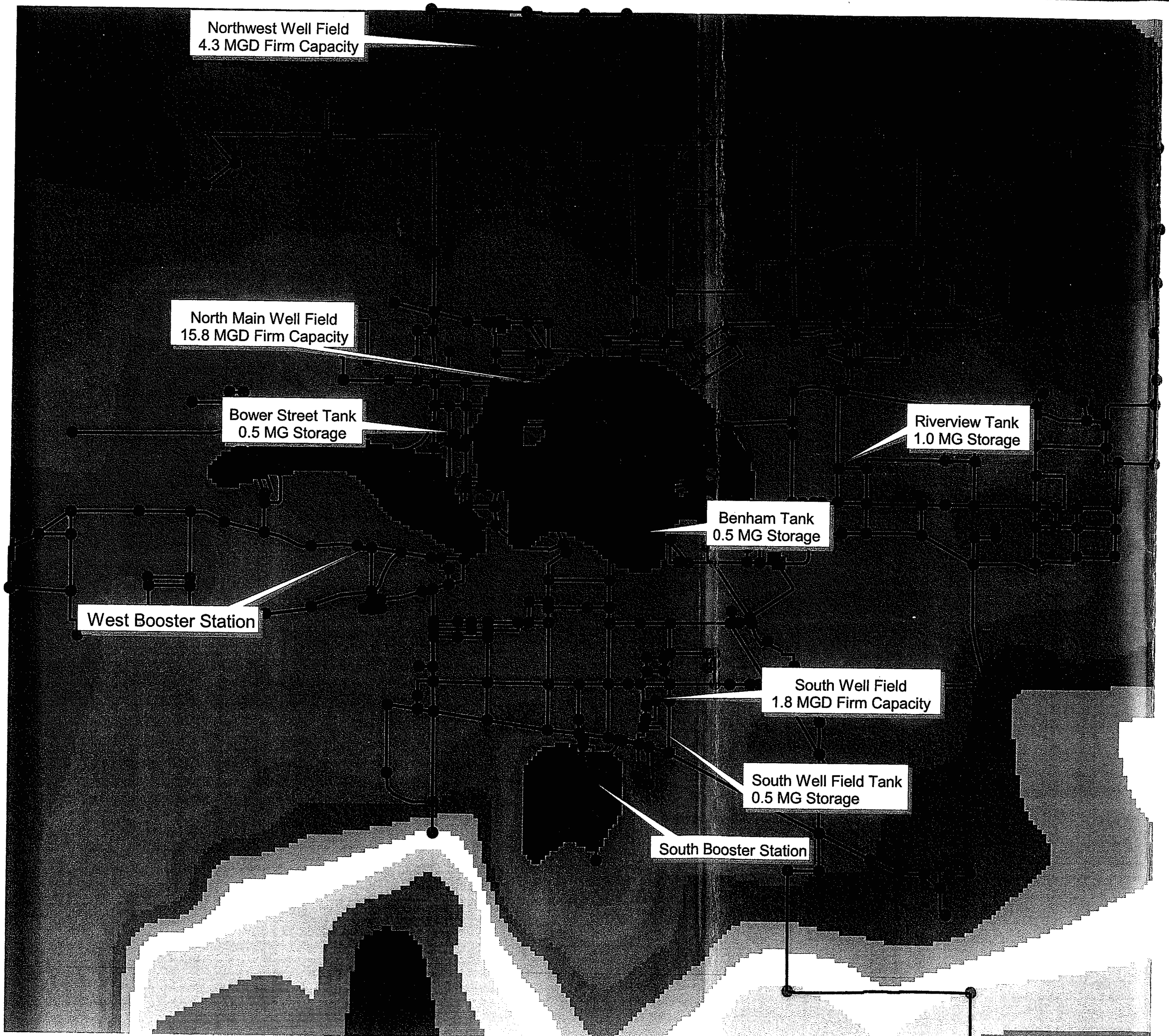


Figure 2.1

City of Elkhart Existing Water Distribution System

Maximum Day Event June 9th, 1999

Existing Pipes
System Junctions
Interpolated System Pressures 8:00 PM

0 - 20
20 - 30
30 - 35
35 - 40
40 - 45
45 - 50
50 - 55
55 - 60
60 - 65
65 - 70
70 - 80
80 - 100
Over 100
Negative
No Data

N

4500 0 4500 Feet

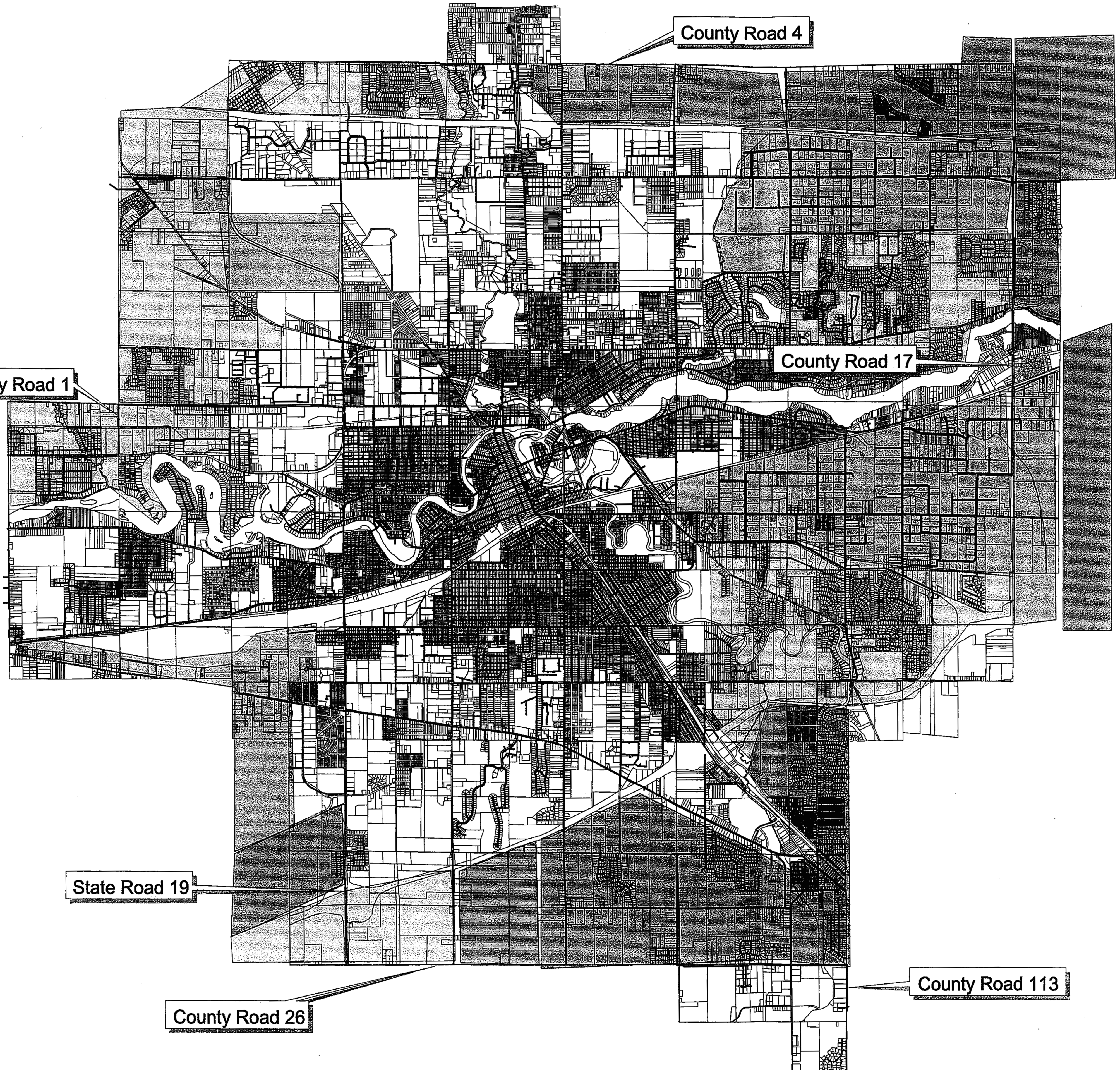


Figure 3.1

City of Elkhart Future Development Areas

Existing System Water Pipes

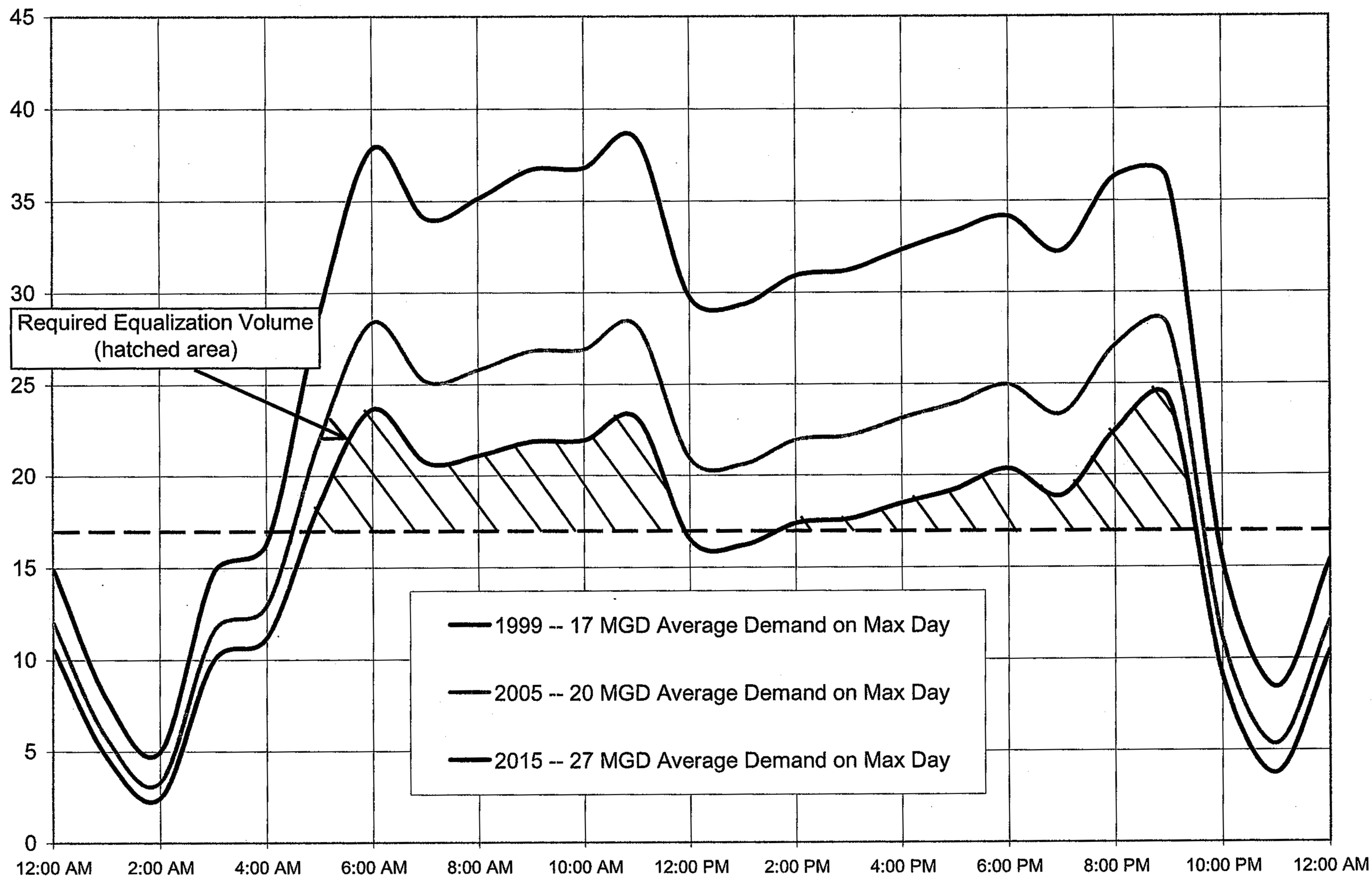
Land Use by Class

- Commercial
- Industrial
- Low Density Residential
- Medium Density Residential
- Office Park
- Park/Recreation
- Public/Institutional
- General Residential

N

5000 0 5000 Feet

Figure 3.2: Present and Future Maximum Day Demands (MGD)



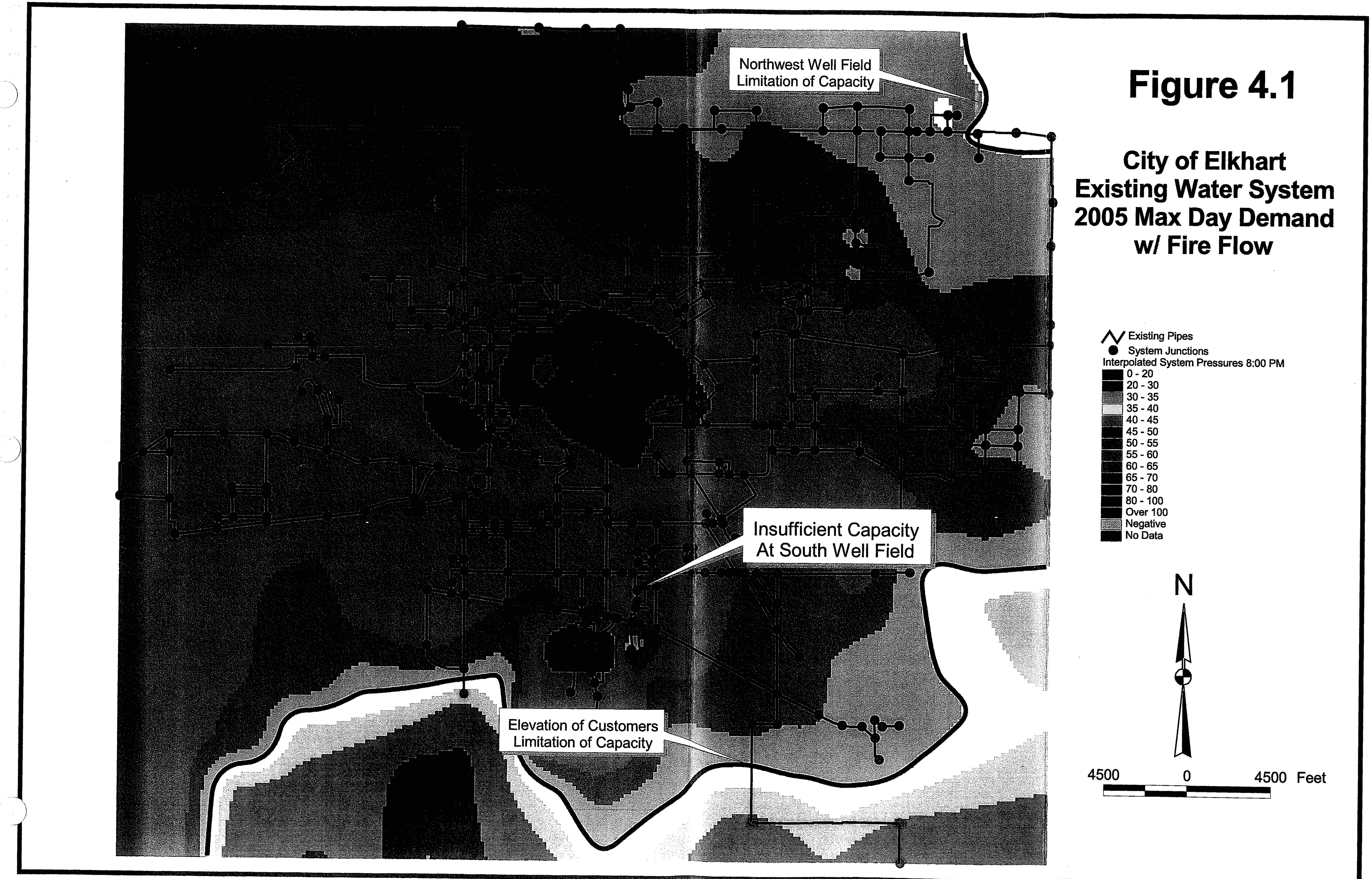


Figure 4.1
City of Elkhart
Existing Water System
2005 Max Day Demand
w/ Fire Flow
Northwest Well Field
Limitation of Capacity
Insufficient Capacity
At South Well Field
Elevation of Customers
Limitation of Capacity
Existing Pipes
System Junctions
Interpolated System Pressures 8:00 PM
0 - 20
20 - 30
30 - 35
35 - 40
40 - 45
45 - 50
50 - 55
55 - 60
60 - 65
65 - 70
70 - 80
80 - 100
Over 100
Negative
No Data
N
4500
0
4500 Feet

Figure 4.2

City of Elkhart Existing Water System 2015 Max Day Demand w/ Fire Flow

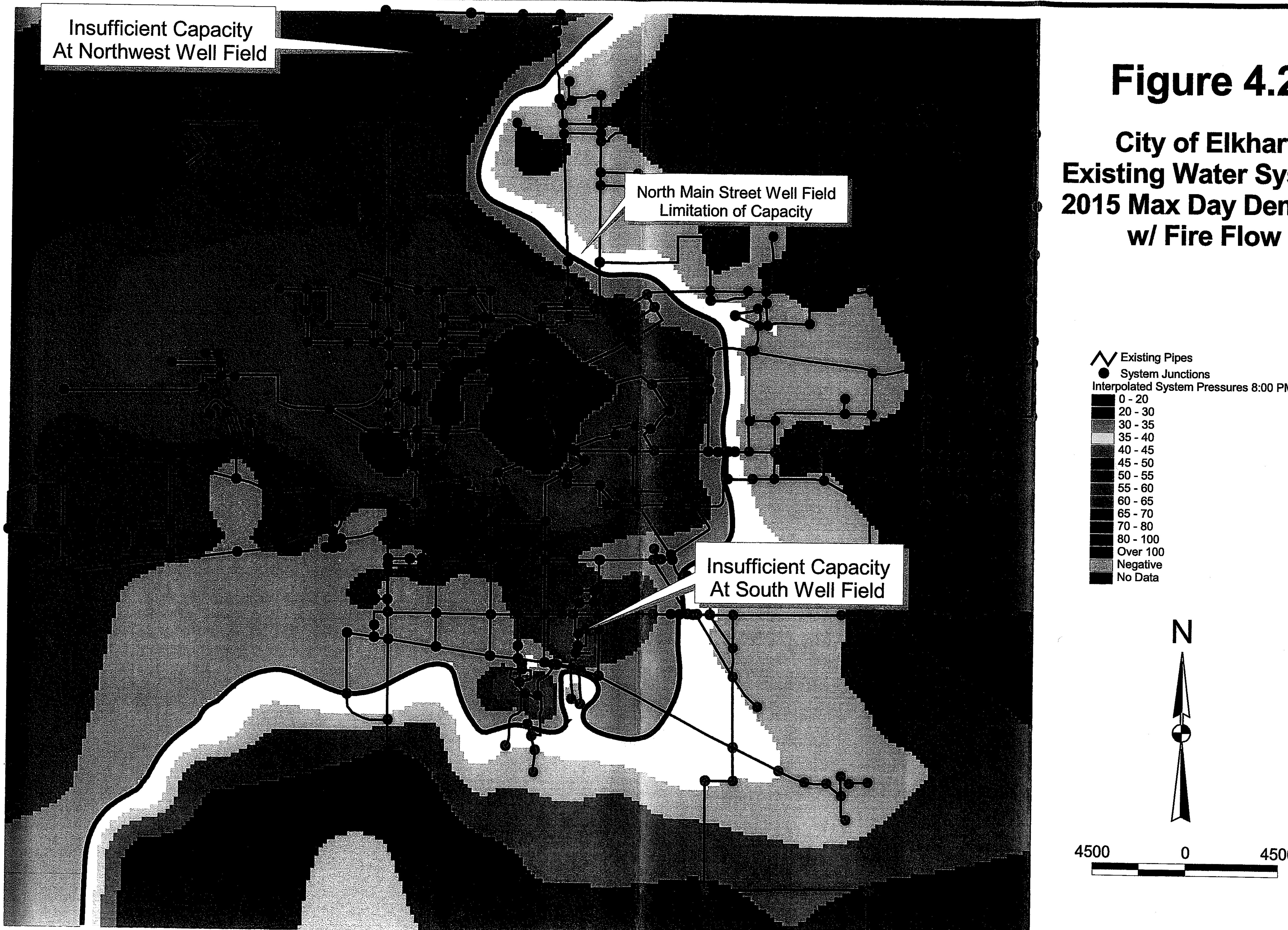
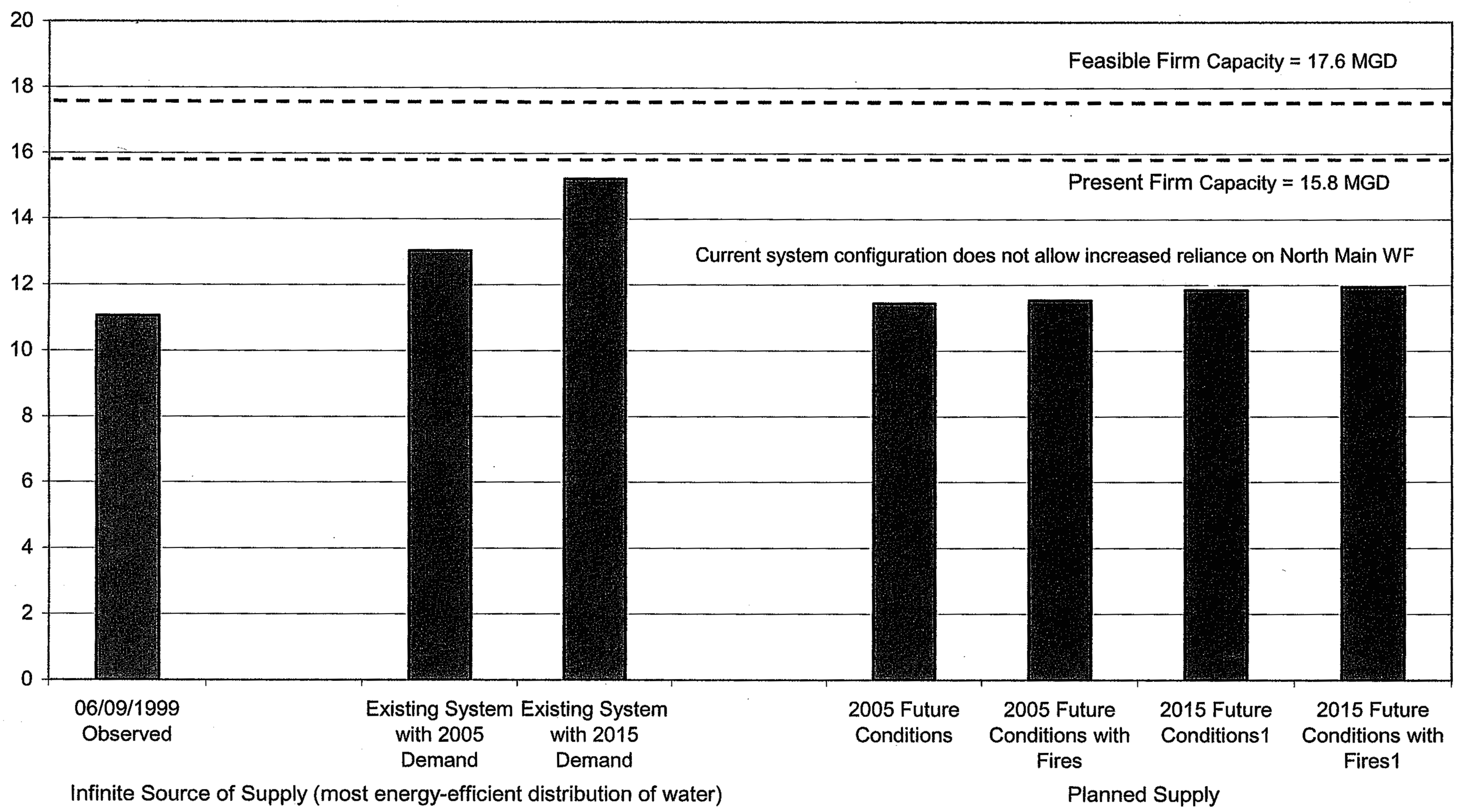
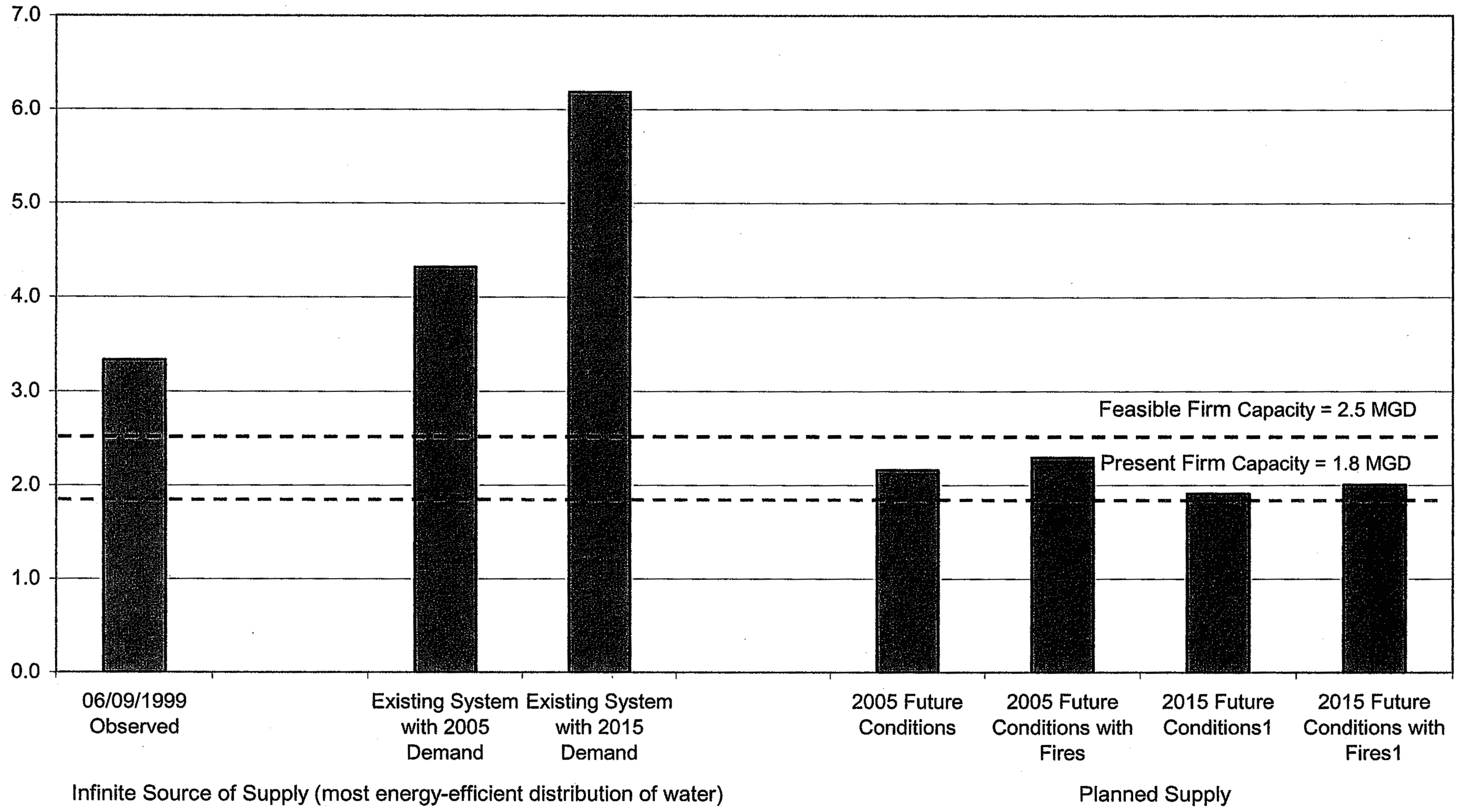


Figure 4.3: North Main Street Well Field -- Projected Supply During Max Day Event (MGD)



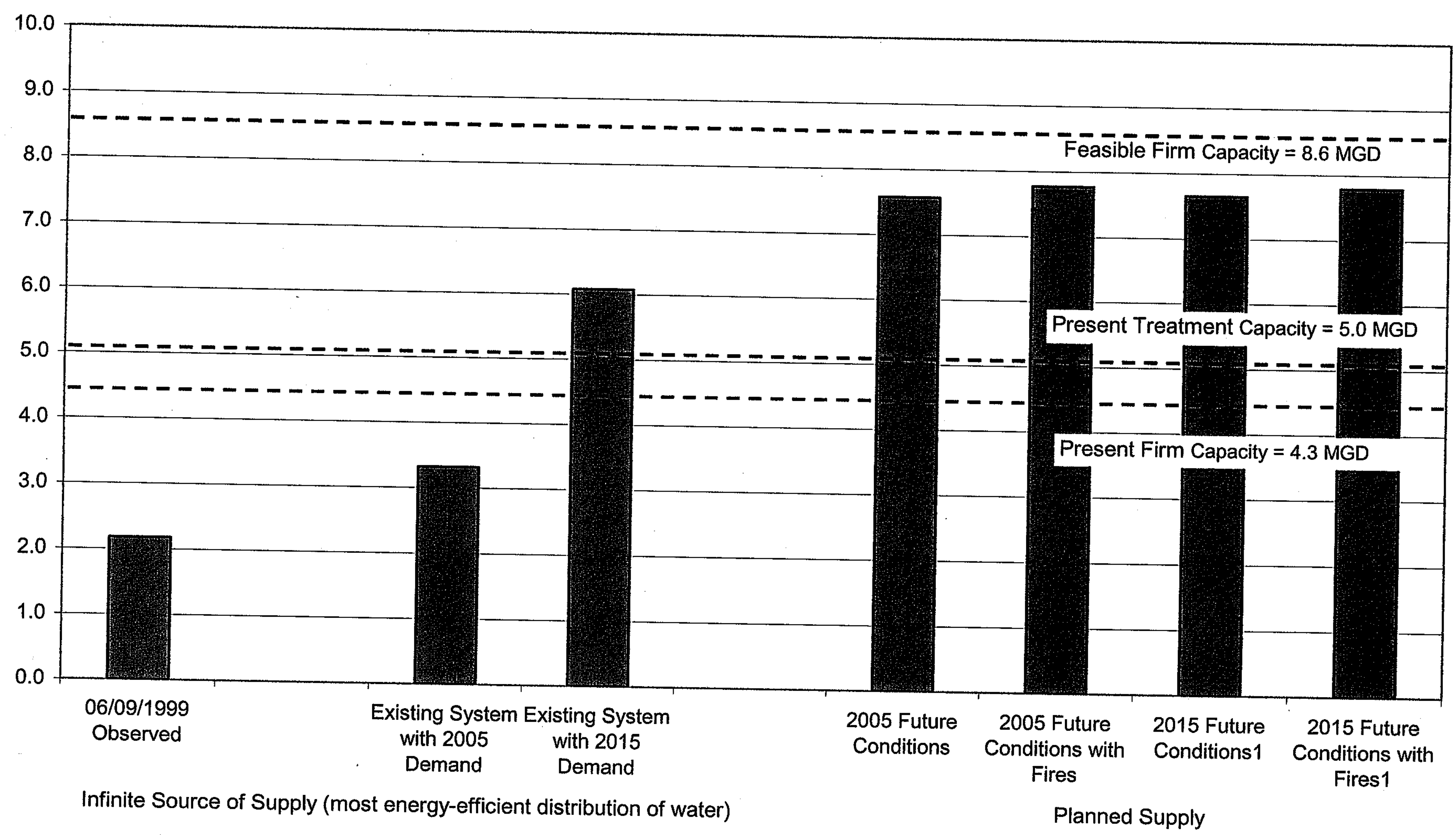
1 The 2015 projected utilization assumes that a new Northeast Well Field and water treatment plant is in service

Figure 4.4: South Well Field -- Projected Supply During Max Day Event (MGD)



1 The 2015 projected utilization assumes that a new Northeast Well Field and water treatment plant is in service

Figure 4.5: Northwest Well Field -- Projected Supply During Max Day Event (MGD)



1 The 2015 projected utilization assumes that a new Northeast Well Field and water treatment plant are in service

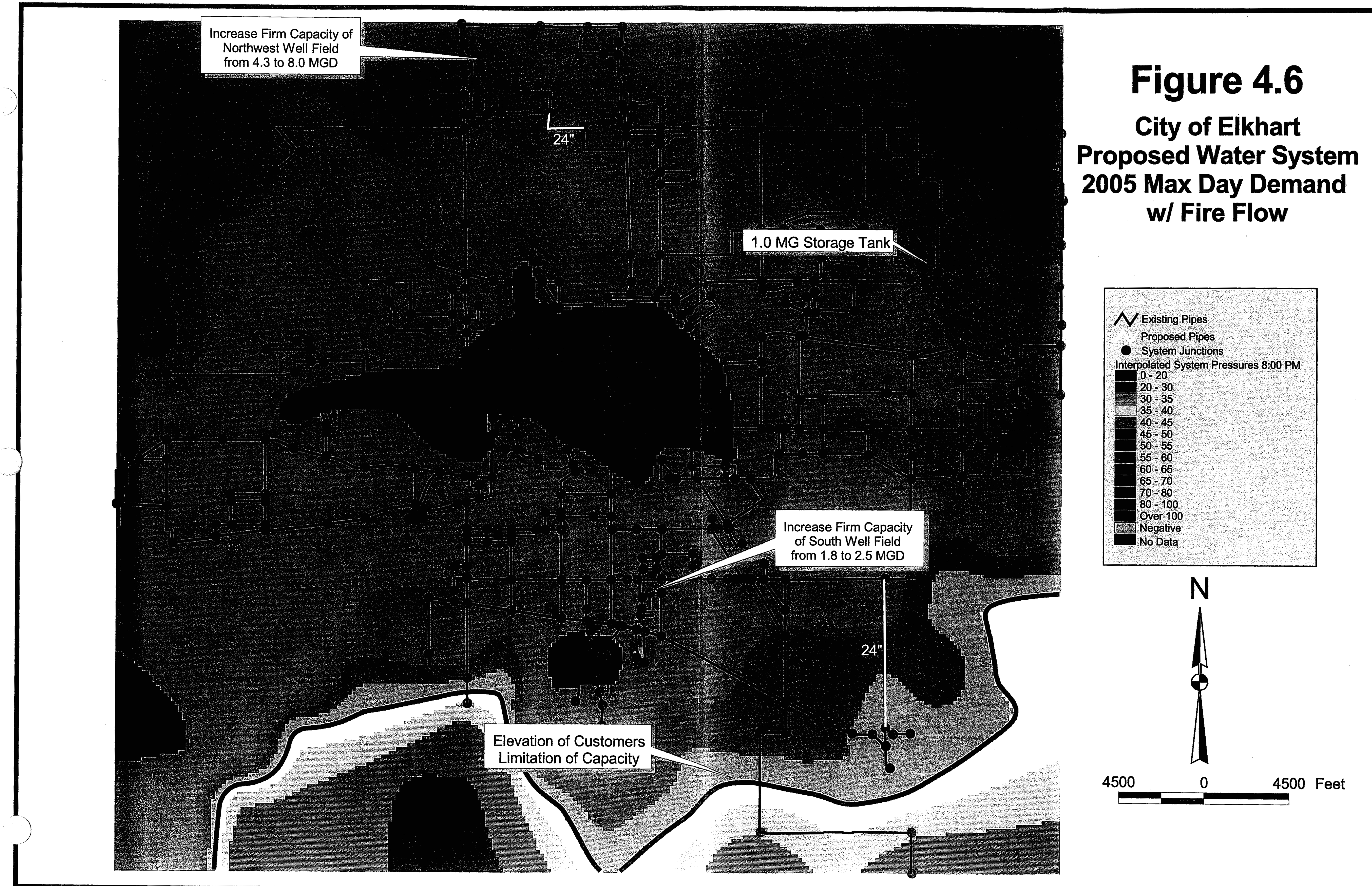


Figure 4.6
City of Elkhart
Proposed Water System
2005 Max Day Demand
w/ Fire Flow
Increase Firm Capacity of
Northwest Well Field
from 4.3 to 8.0 MGD
24"
1.0 MG Storage Tank
Increase Firm Capacity
of South Well Field
from 1.8 to 2.5 MGD
24"
Elevation of Customers
Limitation of Capacity
Existing Pipes
Proposed Pipes
System Junctions
Interpolated System Pressures 8:00 PM
0 - 20
20 - 30
30 - 35
35 - 40
40 - 45
45 - 50
50 - 55
55 - 60
60 - 65
65 - 70
70 - 80
80 - 100
Over 100
Negative
No Data
N
4500
0
4500
Feet

Figure 4.7

City of Elkhart Proposed Water System 2015 Max Day Demand w/ Fire Flow

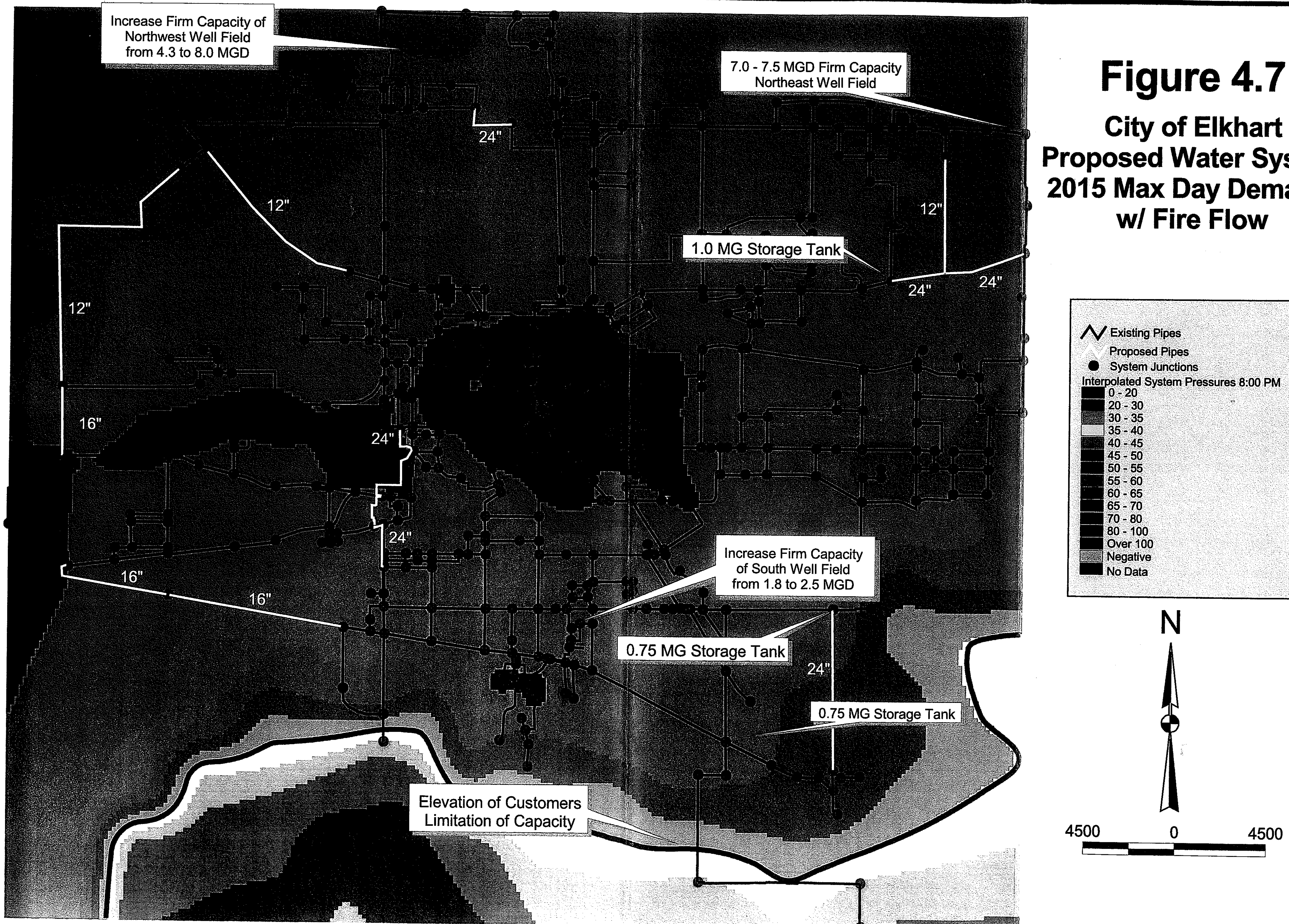


Table 4.3
CITY OF ELKHART
WATER SYSTEM MASTER PLAN

PHASE I: PROPOSED IMPROVEMENTS FOR 2005 (in 2001 Dollars)

Model Element	Project	Purpose	Size or Number	Units	Size	Units	Unit Cost [1]	Units	Subtotal ($)	Contingency [2,3,4,5]	Construction Cost ($)
	Main Improvements										
P-202	24" along CR 6 & CR 7	Close loop south of Northwest WF	24	inch	3,018	ft	146	$/ft	400,000	160,000	600,000
P-202	24" Christiana Creek Crossing	Close loop south of Northwest WF	24	inch	200	ft	400	$/ft	100,000	40,000	100,000
P-342	24" along CR13 from US 33 to Hively	Close loop at southeast corner of system	24	inch	7,639	ft	146	$/ft	1,100,000	440,000	1,500,000
	Storage Improvements										
T-5	1.0 MG elevated composite tank	Meet maximum-day demands for system	1	tank	1.0	MG	1,400,000	LS	1,400,000	630,000	2,000,000
	Water Supply and Treatment Improvements										
	Aquifer Testing and Preliminary Design -- Northwest Well Field and South Well Field		1	study			320,000	LS	320,000	80,000	400,000
	South Well Field Expansion (Upgrade Well 1, New Well)	Increase firm capacity from 1.8 MGD to 2.5 MGD	2	wells	0.8	mgd	150,000	EA	300,000	170,000	470,000
	Northwest Well Field Expansion	Increase firm capacity from 4.3 MGD to 8.0 MGD	5	wells	0.8	mgd	150,000	EA	750,000	410,000	1,200,000
	Northwest Well Field Supply Treatment Expansion	Increase treatment capacity from 5.0 MGD to 8.0 MGD	1	plant	3.0	mgd	1.5	$/gal	4,500,000	2,500,000	7,000,000
							Subtotal:		$ 8,900,000		
							Contingency Subtotal:			$ 4,400,000	
							Total for 2005:				$ 13,000,000

NOTES:
(1) Main costs include asphalt paving
(2) Contingency for Mains was calculated using 40%, which includes the following:
Design, Legal, & Other Services (15%)
Contingency (25%)
(3) Contingency for Storage was calculated using 45%, which includes the following:
Design, Legal, & Other Services (15%)
Contingency (30%)
(4) Contingency for Water Supply and Treatment was calculated using 55%, which includes the following:
Design, Legal, & Other Services (15%)
Contingency (30%)
Electrical & Instrumentation (10%)
(5) Contigency for Aquifer Testing & Preliminary Design was calcuated using 25%

Table 4.4
CITY OF ELKHART
WATER SYSTEM MASTER PLAN

PHASE II: PROPOSED IMPROVEMENTS FOR 2015 (in 2001 Dollars)

Model Element	Project	Purpose	Size or Number	Units	Size	Units	Unit Cost (1)	Units	Subtotal ($)	Contingency (2,3,4)	Construction Cost ($)
	Main Improvements										
P-343	24" along Nappannee from Markle to Franklin	Extend transmission main along Nappanee	24	inch	2,243	ft	146	$/ft	330,000	130,000	460,000
P-344	24" along (offset) Nappannee from Franklin to Indiana	Extend transmission main along Nappanee	24	inch	1,700	ft	146	$/ft	250,000	100,000	350,000
P-382	24" Along Pennsylvania from Nappannee to River Crossing	Extend transmission main across St. Joe	24	inch	3,132	ft	146	$/ft	500,000	200,000	700,000
P-383	24" River Crossing	Extend transmission main across St. Joe	24	inch	500	ft	400	$/ft	200,000	80,000	300,000
P-383	24" River Crossing to Lexington & Wildwood	Extend transmission main across St. Joe	24	inch	2,016	ft	146	$/ft	290,000	120,000	410,000
P-590	16" Along west side of system	Close loop at west side of system	16	inch	3,591	ft	117	$/ft	420,000	170,000	590,000
P-800	12" CR 15 North	Close loop at northeast corner of system	12	inch	5,690	ft	84	$/ft	480,000	190,000	670,000
P-801	24" along Bristol to CR 15	Extend transmission main along Bristol	24	inch	2,692	ft	146	$/ft	390,000	160,000	550,000
P-802	24" along Bristol from CR 15 to CR 17	Extend transmission main along Bristol	24	inch	4,228	ft	146	$/ft	620,000	250,000	870,000
P-803	16" along CR 20 from County Line to CR 1	Extend transmission main along CR 20	16	inch	6,236	ft	117	$/ft	730,000	290,000	1,000,000
P-804	16" along CR 20 from CR 1 to Charlotte	Extend transmission main along CR 21	16	inch	8,871	ft	117	$/ft	1,000,000	400,000	1,400,000
P-805	12" along CR 1 from US 20 to CR 10	Extend transmission main along CR 1	12	inch	14,027	ft	84	$/ft	1,200,000	480,000	1,700,000
P-806	12" along CR 10 from CR 3 to CR 1	Extend transmission main along CR 10	12	inch	9,406	ft	84	$/ft	790,000	320,000	1,100,000
	Storage Improvements										
T-6	0.75 MG elevated steel tank	Meet maximum-day demands for system	1	tank	0.75	MG	1,045,000	LS	1,000,000	450,000	1,500,000
T-7	0.75 MG elevated steel tank	Meet maximum-day demands for system	1	tank	0.75	MG	995,000	LS	1,000,000	450,000	1,500,000
	Water Supply and Treatment Improvements										
	Northeast Well Field Land acquisition (if needed)	Allow for construction of Northeast Well Field	50	acres			30,000	$/acre	1,500,000		1,500,000
	Northeast Well Field Installation	Meet projected 2015 maximum day demands	7	wells	7.5	mgd	150,000	EA	1,100,000	610,000	1,700,000
	Northeast Well Field Treatment Facilities	Treat supplied water from new well field	1	wells	7.5	mgd	1.5	$/gal	11,000,000	6,100,000	17,000,000
								Subtotal:	$ 23,000,000		
								Contingency Subtotal:		$ 11,000,000	
								Total for 2015:			$ 34,000,000

NOTES:
(1) Main costs include asphalt paving
(2) Contingency for Mains was calculated using 40%, which includes the following:
Design, Legal, & Other Services (15%)
Contingency (25%)
(3) Contingency for Storage was calculated using 45%, which includes the following:
Design, Legal, & Other Services (15%)
Contingency (30%)
(4) Contingency for Water Supply and Treatment was calculated using 55%, which includes the following:
Design, Legal, & Other Services (15%)
Contingency (30%)
Electrical & Instrumentation (10%)

City of Elkhart Public Works & Utilities

Our Vision

We will be recognized as a best-in-class utility

Our Mission

- **To serve as a reliable provider of quality water**
- **To maintain customer focus**
- **To foster professional excellence**
- **To serve as a steward of our water resource for future generations**
- **To provide these services at a reasonable cost**

Chapter 2
Purpose

2.1 Need for the Plan

The City of Elkhart Public Works and Utilities began this master planning process for water supply and distribution in 1999. The basic purpose was to update the plan that was prepared in 1986. The update was necessary because of changing demographics in Elkhart over the past decade and the effects those shifts have had on the demand for water supply. Because of the changes in demographics, elements of the 1986 plan needed revisiting to assess their relevancy to today's needs, determine if new elements need to be included, and consider current and future cost implications to the utility.

2.2 Master Planning as a Strategic Plan

The City of Elkhart Public Works and Utilities recognizes the importance of proactive planning in operating and maintaining its services. A key component to this planning process is first forming a strategic plan. This implies critical self-assessment of our goals and objectives as an organization. In the spring and summer of 1999, the staff focused its attention on articulating its *vision* for the utility and its *mission* for carrying it forth. A series of workshops facilitated by an outside consultant[1] helped the staff formulate the current vision and mission statements. The essence of these discussions was centered around three fundamental questions:

1. What do we believe our utility *will* look like ten years hence?
2. What do we believe our utility *should* look like ten years hence?
3. What commitments *must* be made to ensure that we will meet the goals of question 2?

The resulting *vision* and *mission* statements are shown on the following page. A brief summary of the results of these workshops is given in Appendix A of this report.

2.3 Cost

Without a doubt, a fundamental element in proactive planning is preparing for the financial impacts to the community. In this update, alternatives for water supply and treatment are re-evaluated and recommendations selected that carry significant cost considerations for this utility. In this report, the costs associated with improvements are to be thought of as "cost projections" rather than "cost estimates." A cost projection is designed to prepare the utility for the *orders of magnitude* of financial impact that the utility may likely face as the improvements to the system are implemented. These figures are therefore conservative and not to be taken as specific cost estimates. Cost estimates come later when more specific preliminary engineering analyses are performed on the individual components. These "order of magnitude" cost outlines allow utility managers and public utility boards to make more informed decisions regarding funding policies well in advance.

---

[1] Malcolm Pirnie, Inc. Environmental Engineers, Scientists & Planners, Indianapolis, Indiana

2.4 Technology Tools

Since the last master plan for water supply and distribution was completed, significant advances in technology have been made in the "tools" needed to prepare a master plan. In keeping with the commitment to excellence, a third purpose in updating the master plan was to apply a more sophisticated scientific effort to the process. Much of the technology tools relate to computer applications. The City of Elkhart's key tools in this effort were: 1) the Haestad Methods WaterCAD® hydraulic model for simulating the distribution of flow and pressure throughout the system network under specific steady state and continuous demand conditions; and 2) the Geographical Information System (GIS), which is an advanced graphical data management system.

The investments that the City of Elkhart has made over the past decade in technology tools provide a variety of advantages, among which is the ever important function of communication. Because the utility serves the public need, it is critical that the expenditures made to provide these services be effectively communicated. As a result of these tools, this report relies more on communicating the technical details through interfacing these tools graphically and less on mere narrative description.

An example of this is the "Spatial Analyst" tool that is part of the GIS package. This module provides a 2-dimensional surface overlay to differentiate between increment of change of a particular parameter in question. This type of presentation is most effective in summarizing results of complicated technical algorithms. Specifically in this project, the Spatial Analyst tool was used to illustrate how system pressures change as a result of modifications in distribution network configurations.

Chapter 3
Existing Conditions

3.1 Water Supply

The City of Elkhart's supply for potable water comes entirely from groundwater. This supply is provided from three existing production locations: North Main Street Wellfield (located in the city's central core), the South Wellfield (located near the City's southern limits) and the Northwest Wellfield (located north of the City's northern limits). The table below provides an overview of each wellfield's production components and their relative capacities[1].

Table 3.1.1 Existing Production Capacity

	North Main Street[2]	South	Northwest[3]	Totals
No. of Production Wells	**19**	**3**	**5**	**27**
Total Capacity, MGD	**17.27**	**2.98**	**5.40**	**25.65**
Firm Capacity, MGD[4]	**15.83**	**1.82**	**4.32**	**21.97**

3.2 Water Storage

The storage of water is an important element within the distribution system. It serves three functions: 1) provide for fire protection, 2) equalize the system during short-term, high demand periods (such as an hour or two), and 3) to provide some reserve capacity to compensate for the uncertainties in projecting demands and for emergencies other than fires. The current storage capacity in the City of Elkhart system is outlined in **Table 3.2.1.**

Table 3.2.1: Existing Water Storage Capacity

	Volume, MG	Tank Depth, ft	Overflow Elevation, ft (msl)	Tank Type[5]
North Main	2.0	24.0	769.52	Steel, Ground
North Main	2.0	24.0	769.52	Steel, Ground
South	0.5	29.8	892.48	Steel, Elevated
Northwest	2.0	22.0	802.00	Concrete, Ground
Bower St.	0.5	29.8	894.92	Steel, Elevated
Riverview	1.0	30.0	897.46	Steel, Elevated
Benham	0.5	34.0	896.65	Steel, Elevated
	Σ = 8.5 MG			
	Σ Elevated = 2.5 MG			

[1] Capacities are based on pump ratings and pumping data as recorded over the period from 1996-1999.
[2] Includes 4 interceptor wells for the purpose of remediation of groundwater contamination at this site
[3] This wellfield includes two wells that extract groundwater for re-injection into three wells that serve as a barrier to potential groundwater contamination. These well extractions are not included in the capacity calculations because they do not contribute to actual production.
[4] Firm Capacity is the wellfield's capacity with the largest well out of service.
[5] Ground storage facilities are essentially clearwell holding tanks for finished water prior to entering distribution through high serve pumping stations. Therefore, they are not included in network hydraulic analyses for assessing storage needs.

Elevated storage requirements are based on three components: equalization, reserve, and fire protection. Equalization is designed for covering daily peak periods where the demand is above the average daily demand. Reserve capacity, normally targeted at 10% of total available, is designed to cover emergency conditions, e.g., a main break, or a high service pump failure. Fire flow storage is an amount set aside to provide supply for a significant fire-fighting event of a predetermined size and duration, e.g., a 3 MG event over a two hour period. In Elkhart's case, fire protection capacity is available through the high service pumping configurations at the wellfields. The elevated storage capacity is therefore for equalization and reserve only.

At present, the total available elevated storage is 2.5 MG. According to the diurnal pattern of the maximum day demand recorded on June 9, 1999, equalization storage requirement reached 2.9 MG, leaving a storage deficiency presently at 0.4 MG.

3.3 Water Distribution Network

The City of Elkhart Water Utility owns and operates nearly 330 miles of water main, distributing potable water to more than 17,500 point of use customers. The system currently includes approximately 3100 valves for flow control, and 2100 fire hydrants for fire protection and main maintenance. The current standard main material for new main installations is ductile iron. Currently, about one-half of the total water main length is ductile, with the other half being cast iron material. Approximately 1/3 of the system is made up of 6" diameter, or less. The largest lines in the system are transmission mains having 24-inch and 36-inch diameter segments. To maintain adequate pressures throughout the system, two pressure booster stations are presently serving the system. These elevate pressure for areas of the system that are either high in elevation relative to the high service pumping stations at the wellfields, or areas that have less than ideal flow circulation causing drops in pressure. In 1998-99, the utility conducted a water audit[6] for its distribution network. Results of that study, as outlined in **Table 3.3.1**, indicate the network to be operating within standard limits.

Table 3.3.1: Water Accountability

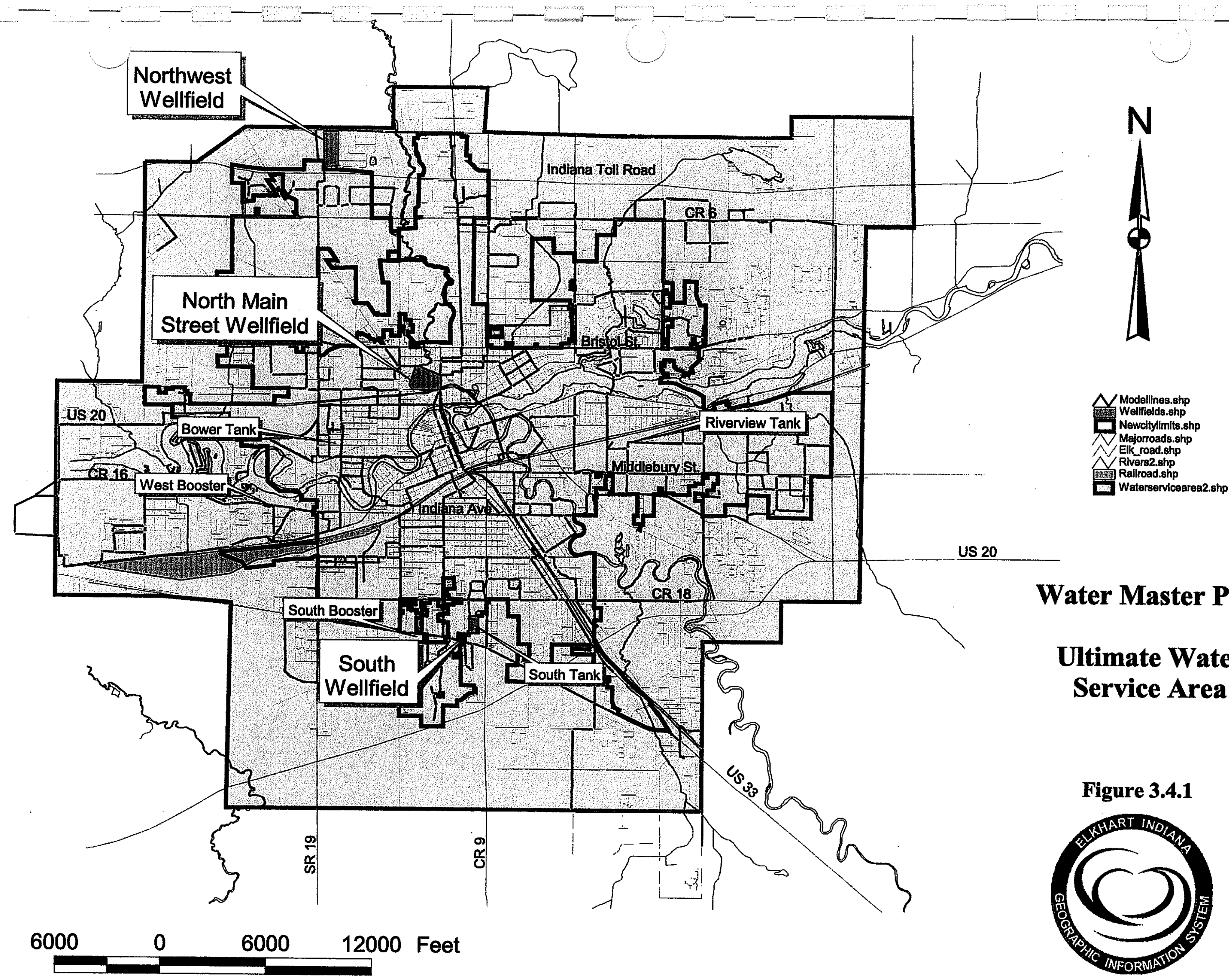
	Percent Accountable
Metered Use	89.8%
Meter Loss – Error & Undersizing	4.0%
Unavoidable Leakage	3.1%
Leakage	3.0%
Summer Flushing	0.1%

3.4 Water Service Area

Figure 3.4.1 is a layout of the City of Elkhart's Water Service Area. This area currently covers 37 square miles, with ultimate planned for 47 square miles.[7] Included is a layout of the existing water distribution network, including the locations of the wellfields, storage facilities, and booster stations.

[6] *Water Audit for Elkhart, Indiana; September 1999*, Pitometer & Associates, Inc. Consulting Engineers

[7] Though the utility's revenue structure is currently regulated by the Indiana Utility Regulatory Commission (IURC), the commission does not regulate the extent of the service area from which revenues are drawn.



Water Master Plan

Ultimate Water Service Area

Figure 3.4.1

Chapter 4
Water Demand Projections

4.1 Establishing Existing Water Demand

4.1.1 Traditional Protocol

Traditionally, estimating existing demand for water usage for long-range planning projections has been based on land use and zoning characteristics. Water usage rates are generalized for each land use category based on statistical models developed from regional and national data sets. As example, for a residential land use, zoned as "single family," standards might suggest that an average daily water usage for this category in this region would be 80 gallons per person per day. Similarly, for a commercial land use, zoned "small business," the standard may be a figure of 20 gallons per day per person, and so forth.

Generally, a map is prepared showing the geographic boundaries of the various land uses to be served and the area for each category tallied. Then the appropriate water usage rate is applied to each area. The result is one average daily water usage value for each mapped area. Typically, this average daily rate is multiplied by "peaking factors" to reflect the demand during a maximum usage day (likely during a drought period) and a maximum usage hour (perhaps due to a large fire fighting activity). Again, these peaking factors are set by industry standards.

In constructing a model to represent the supply and distribution system, the water demand value for a specific area is then applied to a point, called a "junction." This point may represent demand information for more than one area. Lines, called "pipes" or "links" connect the junctions. These lines represent the pipelines sized to convey the water volumes and rates required to meet the respective demands. The result is a "model" that simulates the distribution of the water volume available (from the sources of supply) for use and the rate at which it can be delivered. **Figure 4.1.1** illustrates traditional modeling techniques.

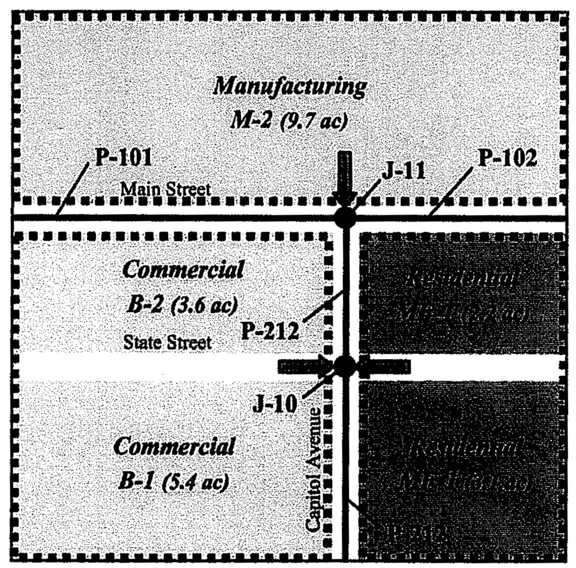


Figure 4.1.1

4.1.2 Conventional Calibration Methodology

In developing a hydraulic model to simulate the existing distribution network, it is important to calibrate the simulation. First, the model's results are compared with actual measurements made in the field. Typically, water volume and rate inputs from the sources of supply and coincident systems pressures and flow rates at strategically selected points in the system are monitored for a period of time. If results differ significantly from what the model predicts under the same conditions, adjustments to the model's inputs are done. This process of "adjusting" parameters is called calibration, and typically made on two fronts. When water demands are estimated based on the traditional methods described in 4.1.1, the first series of calibrations is typically with the demand values. This adjustment relates to the rate and quantity of water flow. Secondly, flow through a pipe network is resisted by friction, the magnitude of which depends on the degree "smoothness" of the pipes. In general, friction increases with age of the pipe. With increasing resistance, more energy is lost in the system, therefore reducing the system pressures in that area. The calibration for pressure relates mostly to adjusting the "roughness" of the inner walls of the pipes in the network to more accurately reflect the true frictional characteristics. Through an iterative process of making adjustments, re-running the model, and comparing with field tests, the model eventually achieves calibration for the existing conditions. Once calibrated, the model can be used to predict the performance of the system under differing scenarios of future water usage.[1] These may include increases (or decreases) in demand due to shifts in local demographics, geographical changes of junctions with significant demands, changes in sources of supply, and changes in storage. If performance proves deficient, the engineer/planner can model improvements to the system until performance criteria are satisfied. It is these improvements, then, that become the basis for the capital improvement program.

4.1.3 Estimating Demand for the Elkhart Model

The Geographic Information System (GIS) technology tool used by the City of Elkhart provides an improved, cost-effective methodology for estimating the water demand. Within the GIS framework, a module known as "geocoding" links, or addressed-based information, to a specific geographic location. That location is defined by the postal address. The City of Elkhart water utility maintains a database of all its metered water customers (for billing purposes primarily) which includes site addresses. In this data set is information regarding each customer's actual monthly water usage (meters are read once monthly). From this information, actual water usage "habits" can be reasonably determined for every customer. Therefore, instead of merely estimating water usage based on what may be typical for a particular land use, meter information more accurately reflects *actual* usage. Using the GIS geocoding tool, the meter database was linked to each respective meter location on a detailed map of the City's water service area. Existing condition demands were then developed for inputs at designated junctions within the hydraulic model by aggregating customer sites around specific junctions based on proximity to the junction and the sizes of pipes leading to and from the junction.[2] **Figure 4.1.3** illustrates this concept.

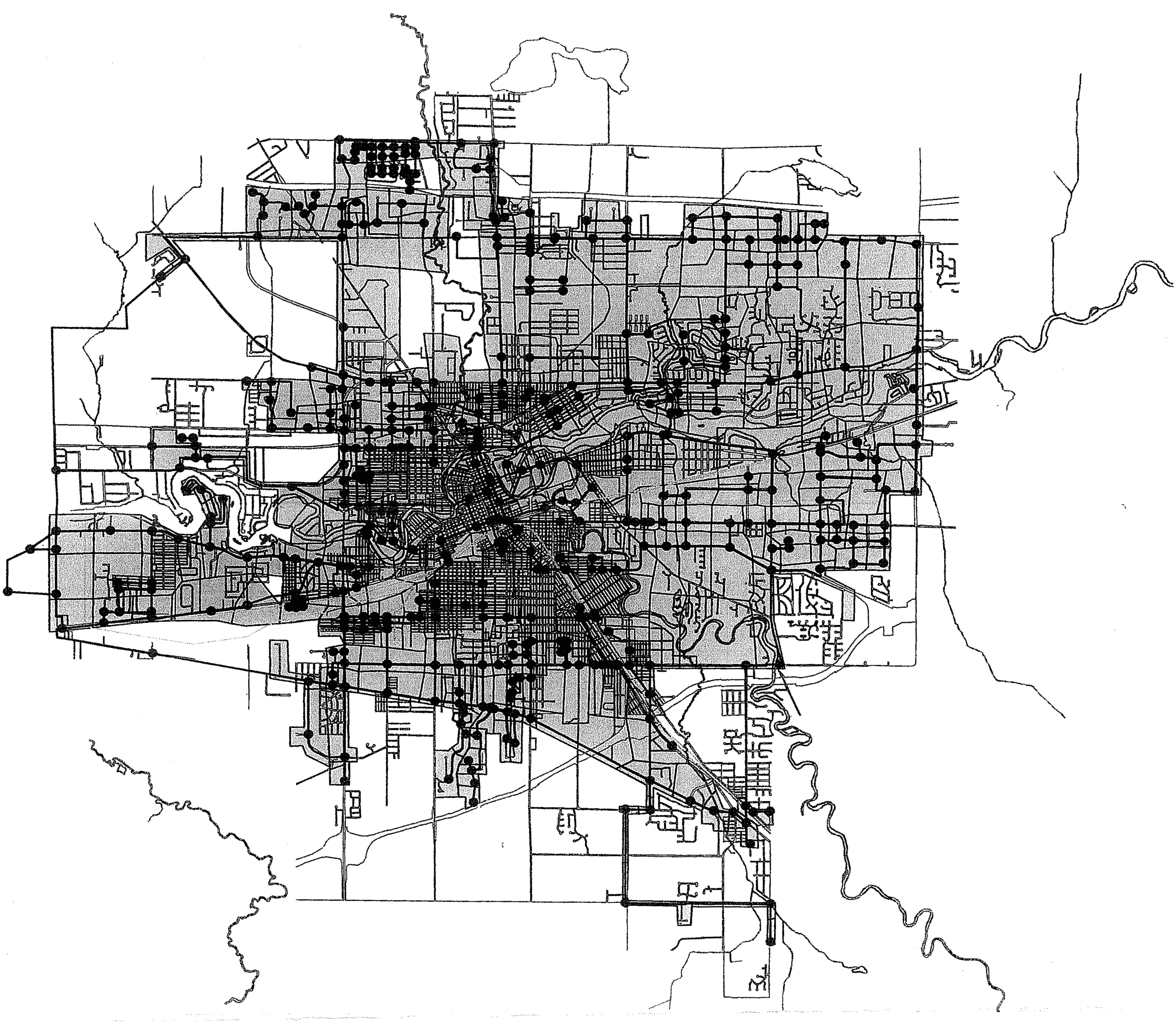
Another advantage to this type of demand projection is that it minimizes the amount of field testing necessary to calibrate the model to within standards for master planning. Using this r .thod, the model was calibrated to within 10% of field data on the initial model runs. It is understood that as planning moves into implementation, it will be essential for staff to conduct more detailed field test for flow and pressure to bring calibrations to within design standards.

[1] It should be noted, that the degree of calibration accuracy is a function of the level of detail the water planner/engineer desires. For long-range planning efforts, modeled results to within 10% of the field conditions are adequate. For detailed design, however, calibrations should be more within 3-5%.

[2] Since meters are read monthly, and model simulations are concerned with the maximum day demand (most critical demand over a 24-hour period), the diurnal pattern established for the maximum day was derived from the pumping patterns logged during the maximum day occurring within the three years of data researched (found to be June 9, 1999).

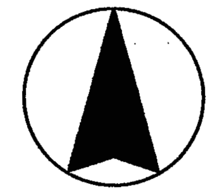
Water Distribution Sytem System Model

City of Elkhart Public Works & Utilities
Demand Polygons



Legend

- Demand Polygons
- Model Pipes
- Model Nodes
- 1999 Water Service Area - 23,900 Acres



No Scale

Figure 4.1.3

But since demands are already allocated with considerable accuracy due to the geocoding process, calibrations would need focus primarily on frictional characteristics of the system. A complete description of the demand projection methodology used in the development of the hydraulic model can be found in the technical memorandum[3] in Appendix B and in the technical paper[4] in Appendix D of this report.

4.2 Projecting Demands for Future Planning

Once existing demands have been established (i.e., a calibrated model), a method for projecting how these demands may change in the future must be developed. Traditionally, water engineers/planners have relied on census data and comprehensive land use plans to extrapolate population changes through the planning horizon, which may extend out 10 to 20 years. Based on these data, new estimated are developed for the water usage using the same methods as described in 4.1.1. Because of the uncertainties associated with land use planning and long-term economic growth, rarely do these projections hit their target. This often requires major revisions to the capital improvement plan and implementation schedules, and depending on the severity, may require a complete new master plan.

In developing the methodology for projecting demands for the Elkhart water master plan, it was determined that several projection models be developed, and final selection be based more on experience and knowledge of our local economy in conjunction with the statistics.

4.2.1 Methodology

Elkhart average daily pumpage data from 1964 to 1998 was collected and plotted. The data differentiated into two groups representing two apparent rates of growth for the community. The first occurred between data from 1964 and 1988. During the initial 24-year period, the data indicates that daily pumpage rate increased approximately 0.04 MGD per annum. This set of data was called the "longer-term historic" set.

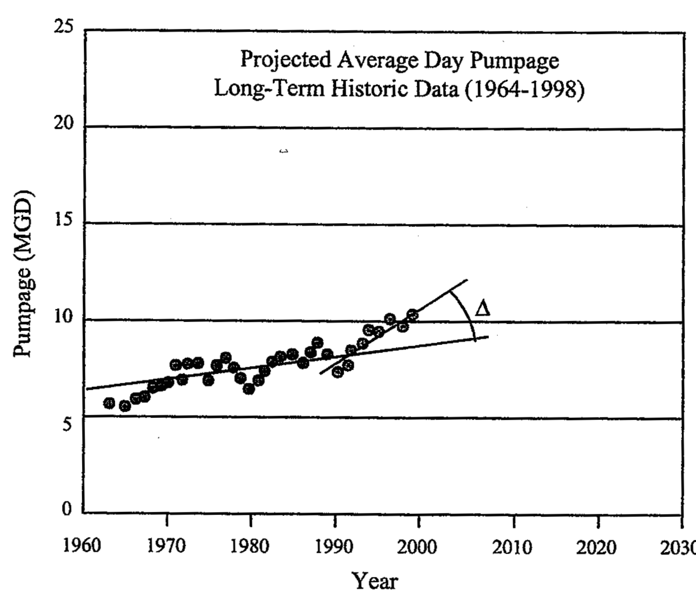


Figure 4.2.1

However, in the second group, called the "near-term historic" data set, the rate of change increases. For these years, the daily pumpage

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[3] *Distribution System Hydraulic Model: Allocation of Water System Demands*, October 2000, Malcolm Pirnie, Inc., Indianapolis, Indiana

[4] *Utilizing GIS in Developing Realistic Demand Distributions to Support WaterCAD Modeling in Water Supply Master Planning*, July 2001

rate increased significantly to approximately 0.25 MGD per annum, bringing the current average daily pumpage to about 10.4 MGD. The increase can attributed to: increased standards of living in recent years, and growth in customer accounts.[5] The graph in **Figure 4.2.1** illustrates this growth.

Because of the trends of the recent decade, it was decided that projections for the planning horizon should be based on the second, more recent grouping of the pumpage data. Four statistical models were applied to determine the best fit of the data. The linear and logarithmic models (as denoted by the R^2 values) fit the data well, with the linear providing the best fit (see **Figure 4.2.2**). By extrapolating either of these through the planning horizon year of 2015, the average daily pumpage rate is projected at 14.7 MGD. Both the power and exponential function models also mirror one another. Their projection, however pushed the average daily pumpage rate to approximately 16.4 MGD for the year 2015.

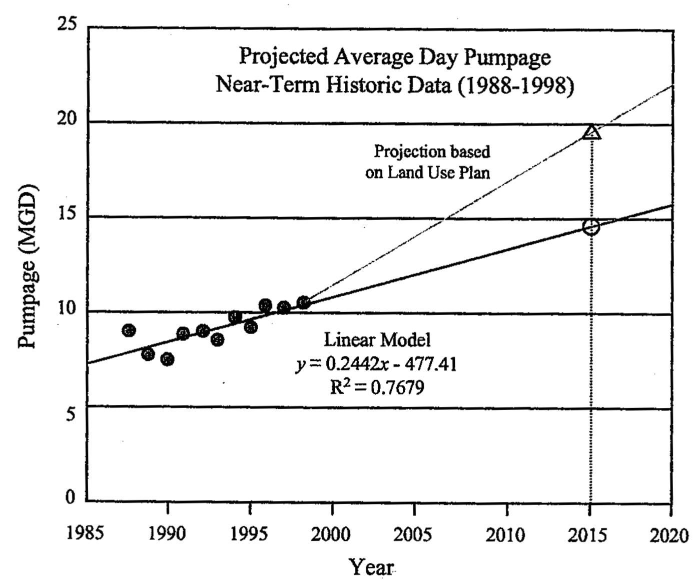

Figure 4.2.2

Finally, since tradition has it that land use be considered in projecting community growth, the pumpage rate for the year 2015 was calculated and plotted based on the level of development predicted by the projected land use for the service area.[6] This value plotted at 19.6 MGD for the average daily pumpage rate. This is also plotted in Figure 4.2.2 After review of all projection models, it was decided that the traditional methodology of utilizing land use was over-predicting the required water needs for Elkhart, and that the statistical models that best fit the near-term historical data provide the more realistic projection. Therefore, the master planning process would focus on a need to provide an average daily pumping rate of 14.7 MGD by the year 2015. A summary is provided in **Table 4.2.1**. Additional information regarding the demand projections can be found in the technical memorandum[7] in Appendix B.

Table 4.2.1: Projections of Average Daily Pumpage for Master Plan

	Existing Condition	Planning Year 2005	Planning Year 2010	Planning Year 2015
Pumpage Rate, MGD	10.4	12.1	13.4	14.7

[5] In 1995-96, the Water Utility added nearly 1,500 customers resulting from the Conrail Project. Additionally, the 1999 purchase of Suburban Utilities added more than 400 customers.
[6] *1996 Comprehensive Land Use Plan*; projects land uses for a proposed 2015 Urban Services Area
[7] *Water Supply Evaluation; Brainstorming Session: Projected Water Demands and New Water Supplies*; Malcolm Pirnie, Inc., Indianapolis, Indiana

4.3 Projecting Supply for Future Planning

A critical step in the planning process is establishing the level of capacity of the current sources of water supply to meet projected demand. The process involves evaluating the existing capacity of the sources and determining if that capacity can consistently deliver the requirements of the projected demands through the planning horizon. As noted in **Table 4.2.1**, the average daily demand is projected to increase from 10.4 MGD to 14.7 MGD by the year 2015. Further analysis of the near-term historical data set found that the average peaking factor for the maximum day was 1.9[8]. Applying this factor, the maximum day demand is expected to increase from 19.8 MGD currently to 27.9 MGD in 2015. Currently, the firm capacity of the water sources in Elkhart is approximately 22.0 MGD.[9] Capacity need is determined by the difference between the maximum day and the system's firm capacity. Under these conditions, assuming demand rates increase as described, the City of Elkhart system will enter deficit capacity by 2005, and be deficient by 5.9 MGD by the year 2015. This is illustrated in **Figure 4.3.1**. This is additional capacity is the *minimum* that must be developed to supplement what currently is in place. This assumes all existing water supplies remain viable throughout the planning period. That is, all existing wells continue to produce at current rates (aquifer yield sustainability), and with water of acceptable quality. If any prove not to be viable, then the increase in supply must compensate accordingly. Following further evaluation of the existing supply sources, it was concluded that a more realistic deficit would be 8 MGD to account for those sources potentially not proving sustainable. Developing sources of supply to this magnitude will likely require expanding existing well field sites and constructing a new well field. More information on projecting supply can be found in the technical memorandum[10] in **Appendix B.**

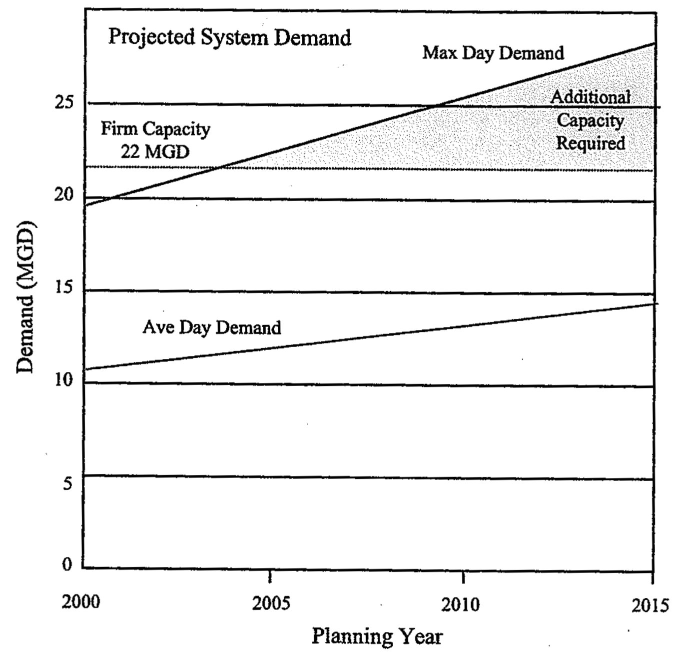

Figure 4.3.1

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[8] Peaking Factor is the ratio of the maximum day to the average day demand.

[9] Firm capacity in this context is defined as the capacity of the groundwater source with the largest producing well out of service, and applies to all wellfields.

[10] *Water Supply Evaluation: Evaluation of Alternatives*; Malcolm Pirnie Inc., Indianapolis, Indiana

4.4 Evaluating Alternatives for Increasing Supply

With a clearer picture of Elkhart's future water supply needs, the master planning process next moves to identifying feasible alternatives for measures to close the projected deficit in supply. Once identified, each alternative was prioritized using a composite matrix analysis procedure. Fourteen alternatives were identified. These are listed in **Table 4.4.1**. Each alternative was then evaluated based on ten criteria. Each criteria received a "High", "Moderate" or "Low" *favorability* rating. These criteria are listed in **Table 4.4.2**. A favorable alternative received many "High" ratings, while an unfavorable alternative received many "Low" ratings. Because of the subjectivity of the rating process, evaluations were conducted from 12 independent sources. A numerical index was assigned to the "H", "M" and "L" ratings. The results for each were compiled and the averages computed. From these results, the alternatives receiving the highest numerical values were considered the most favorable. Of the 14 original alternatives, the 4 highest were selected for further consideration and analysis. The complete results of this analysis are given in the technical memorandum[11] in **Appendix B**.

Table 4.4.1: Ranked Order of Alternatives for New Supply Sources

Alternative
1. Add capacity to Northwest Wellfield
2. Water Conservation
3. Redrill and Rehab wells at North Main St
4. Add capacity to South Wellfield
5. Additional storage
6. Bayer Wells
7. Water purchase
8. Groundwater recharge system
9. Regionalize water supply
10. Induced infiltration of surface water
11. Construct new wellfield
12. Direct intake of St. Joseph River
13. Water reclamation
14. Direst intake of Lake Michigan

Table 4.4.2: List of Alternative Evaluation Criteria

Criteria
1. Water Quality
2. Vulnerability to contamination
3. Land availability, acquisition and control
4. Source sustainability and interference
5. Source yield
6. Environmental and ecological impacts
7. Proximity to existing infrastructure
8. Treatment issues
9. Public Acceptability
10. Time Factors

It is interesting to note that as an alternative, "Water Conservation" scored quite high. Water conservation refers to a paradigm shift in water planning.[12] Traditionally, water utilities respond to growing demand by focusing its sources of supply. No attention is paid to managing the actual demand. In areas of our country where water supplies are scarce, managing demand for the water is becoming increasingly critical. Though water quantity is not an issue here in the mid-west, it should not excuse us from being conscious of our habits of water use. The fact that this alternative scored high reflects this conscientious attitude present in the City of Elkhart.

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[11] *Results of Matrix Analysis to Determine the Highest Priority Alternatives*; Malcolm Pirnie, Inc., Indianapolis, Indiana

[12] General information on Water Conservation strategies can be found in the technical memorandum, *A Summary of Case Studies and Recommendations for Implementing "Beat-the-Peak" Strategies*, Malcolm Pirnie, Inc., Indianapolis, Indiana located in Appendix B.

Addressing conservation issues is currently being done through public education programs. It is hoped that as the planning period progresses, the rate of increase in water demand actually falls below projection not because of lesser growth, but because we have gained a better knowledge of how best to use the resource we have. Economically speaking, conservation has distinct benefits for it can delay the timing of infrastructure needs, thereby deferring financial obligations associated with those needs.

4.5 Feasibility of Expanding Existing Wellfield Capacities[13]

4.5.1 Northwest Wellfield

The top-ranked alternative was to expand capacity at the Northwest Wellfield. Expansion there would mean adding production wells. Evaluations show that up to four additional wells (at 750 gpm each) could conceivably be added. This would result in a lowering of the groundwater levels approximately 5 to 7 feet in the existing wells due to drawdown interferences, but within acceptable standards. This would bring the wellfield total production capacity to 9.7 MGD, with a firm capacity of 8.6 MGD. This expansion obviously requires additional treatment capacity at the existing iron removal plant. The existing treatment plant train has a treatment capacity of about 5.6 MGD, but was built with future treatment expansion capacity of 10 MGD. The high service pumping station[14] is built with expansion capacity up to 18.6 MGD.

4.5.2 South Wellfield

Evaluation of expanding production capacity at the South Wellfield indicates that adding one well (800 gpm) would lower the groundwater levels in the existing wells by up to ten feet. Adding a second well (also 800 gpm) would lower the levels an additional ten feet in the existing wells. With one additional well, adverse effects would be seen in only existing production No. 1.[15] With two additional wells, adverse drawdown interferences would be seen in existing wells 1 and 2.

A feasible expansion would consist of abandoning existing production Well No. 1 and replacing it with a new 800 gpm well, and adding a new 800 gpm well, bringing the total number of wells at the site to 4. The resulting total potential capacity would be about 4.7 MGD, with a firm capacity of 3.3 MGD.

4.5.3 North Main Street Wellfield

Expansion at the North Main Street Wellfield campus is complicated by the fact that wells are shallow (generally 40 to 60 feet) and relatively close in proximity to one another. Consequently, the drawdown interferences are complex resulting in several wells producing at rates as much as

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[13] Details for this section can be found in the technical memorandum *Water Supply Evaluation: Evaluation of Alternatives*, October 2000, Malcolm Pirnie, Inc., Indianapolis, Indiana, in Appendix B

[14] *Elkhart, Indiana: Northwest Well Field - Operation & Maintenance Manual, Basis for Design*, August 1992; Greeley and Hansen Engineers, Indianapolis, Indiana.

[15] Historically, production performance of Well No. 1 at South Wellfield has been poor due to chronic biofouling. Rehabilitation efforts have proven only moderately effective.

only half their design capacity and operated only during periods of high demand (historically typical for Wells A through E). This brings up the possibility of installing new, much deeper wells. These wells would penetrate the clay aquatard that separates the upper and lower aquifer formations. Drawing from the lower, confined aquifer would feasibly produce 800 gpm in each new well.

The concept for North Main Street Wellfield would be to abandon wells A through E and replace with four wells. Two would draw from the upper aquifer and two from the lower aquifer, all drawing at a rate of 800 gpm. The result would be decreasing the periods of operation on existing wells, and by increasing the distance between wells reduces the drawdown interference. This program would increase the total potential production capacity at the wellfield to 19.0 MGD, with a firm capacity of 17.6 MGD. It should be noted that such an expansion would also require a treatment facility at this wellfield primarily for iron and manganese removal, and an upgrade to the disinfection and fluoridation capacities.

Table 4.5.1 summarizes the capacity potentials at these three existing wellfields if the expansion alternatives were pursued. This set of alternatives brings the system's firm source capacity to meet the near 28 MGD projected maximum day demand (Figure 4.3.1) by more than 5 percent. However, due to the physical configuration of the distribution system, actual delivery of the source water to all points of demand is not feasible hydraulically. Because of this, though source capacity may exist, it cannot be effectively utilized. Such is the case at both North Main Street and South Well fields. This in known as "unrealized capacity."

Table 4.5.1: Summary of Wellfield Expansion Capacities (all values in MGD)

	Existing Capacity		Feasible Capacity		Capacity Increase	
	Total	Firm	Total	Firm	Total	Firm
Northwest	5.40	4.32	9.72	8.64	4.32	4.32
South	2.98	1.82	4.46	3.31	1.48	1.48
North Main	17.27	15.83	19.00	17.56	1.73	1.73
Grand Totals	25.65	21.97	33.18	29.51	7.53	7.53

Consider North Main Street Wellfield. If the aquifer yield to this facility were infinite, one finds that even under the 2015 demand conditions, the actual volumes removed from the field is still less than its current firm capacity. This is due to the fact that the distribution system cannot effectively convey the supply from this field to meet the demands at the extremities of the system (primarily east and northeast). Therefore, it is prudent to assume that North Main Street Wellfield will continue to operate into the future within parameters much the same as it does today, that is, delivering at between 10 and 12 MGD in the maximum day condition.

A similar situation exists at South Wellfield. Though expansion at this facility could feasibly bring the firm capacity to above 3 MGD, hydraulic constrains in the distribution system appear to limit this capacity to about 2.5 MGD (based on the infinite source approach). By implementing the recommended improvements at South Well Field (see 4.5.2), the projected maximum day demand from this facility is projected to reach 2.0 MGD. It could be argued therefore, that the full implementation to the 3.3 MGD firm capacity seems unnecessary since only 2.5 MGD is what the distribution system will convey. It can be shown that replacing Well No. 1 with an 800 gpm well and adding a new well at 500 gpm would provide the field with 2.87 MGD firm capacity. However, potential for future development in the southern extremity of the service area within the planning horizon remains. Should this potential materialize, the South Wellfield would become a key source in providing water to those areas. Therefore, the recommended increase in firm capacity at South Wellfield stands at 3.3 MGD. Prioritizing the well improvements (proceeding with replacement of Well No. 1 or with installing a new well first) is necessary.

For the Northwest Wellfield facility, the infinite source model indicates that 8.0 MGD can be adequately delivered to points northeast and east. The recommendations for improvements at Northwest Wellfield resulted in a feasible firm capacity of 8.6 MGD. Therefore, the improvements as recommended remain.

With the above discussion of unrealized capacities, Table 4.5.2 shows the wellfield capacities to include the limitations on capacity due to the configuration of the distribution system.

Table 4.5.2: Summary of Wellfield Capacities considering Unrealized Capacities

	Firm Capacity (MGD)
North Main Street	11.0
Northwest	8.0
South	2.5
Realistic Firm Capacity	21.5
Firm Capacity Req'd	27.9
Difference	(6.4)

It is clear from Table 4.5.2 that despite the improvements to Northwest and South Wellfields, and the existing unrealized capacities additional wellfield capacity is necessary to close the gap of 6.4 MGD. Mitigating this difference comes in the form of a new wellfield and water treatment facility having a firm capacity of 6 to 8 MGD. This facility would be best located in the northeastern region of the service area due to the demand projections for this area being significant. This facility is recommended to meet the 2015 planning year demand projections. With this facility in place, Table 4.5.2 is amended to show the closing of the capacity gap. This is shown in **Table 4.5.3**.

Table 4.5.3: Summary of Wellfield Capacities with New Wellfield in Northeast

	Firm Capacity (MGD)
North Main Street	11.0
Northwest	8.0
South	2.5
Northeast	7.0
Realistic Firm Capacity	28.5
Firm Capacity Req'd	27.9
Difference	0.6

4.6 Summary

Projecting the demand for water in Elkhart starts with accurately establishing the existing conditions. This was done using the GIS geocoding tool. Average daily demand projected for the year 2015 is 14.7 MGD, with 27.9 MGD demanded on a maximum day. Current capacity to supply this demand will enter deficit by 2005, and will be short between 7 and 8 MGD by 2015, due in part to aquifer yield, but mostly due to unrealized capacity at North Main Street and South Wellfields. Adding capacity to Northwest and South Wellfields and adding a new wellfield are the preferred alternatives to close this deficit.

Evaluating the feasibility of expanding production at each of the three wellfields results in an increase in existing firm capacity of 4.32 MGD and 1.48 MGD at Northwest and South, respectively.[16] With the improvements recommended for the two wellfields, along with the installation of a new well production and treatment facility in the City's northeastern quadrant, the maximum day firm capacity will feasibly be 28.5 MGD, thereby meeting the projected demand for Planning Year 2015.

It should be noted that additional storage in the distribution system is also essential for the equalization of the peak hour demands and to sustain a reserve in the system. These storage improvements are outlined in Chapter 6.

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[16] Hydraulic model results indicate that constraints in conveyance limit the benefit of the North Main Street expansion. Though production could be increased, conveying the increase to the areas of need (primarily on the City's eastern perimeter) is severely constrained by the system's configuration. Therefore, expansion at the North Main Street wellfield is not deemed practical.

All physical systems are integrated. Therefore, whenever one attempts to isolate and model a particular physical system, certain assumptions must be made. These assumptions focus on narrowing the field of variables. This is achieved by simplifying those variables less sensitive to the overall system. By focusing only the critical variables, efficient algorithms can be developed. For the "closed" physical system of a water distribution network, the parameters critical to the model are flow rate and conveyance friction. Their influence on each other is reflected by pressure increases and drops throughout the system. Pressure is a parameter that any user of water understands.

A hydraulic model was developed for the City of Elkhart distribution system. The model used was WaterCAD® for Windows developed by the Haestad Methods, Inc., of Waterbury, CT. The package allows for up to 1000 pipe segments.[1] The purpose of using this application was its simplicity and interface capability with the Geographic Information System platform.

The WaterCAD® model offers five functions fundamental to water master planning.[2] These are:

- Perform steady-state analyses of water distribution systems with pumps, tanks, and control valves.
- Perform extended period simulations to analyze the piping system's response to varying supply and demand schedules.
- Perform water quality simulations to determine the water sources and age, or track the growth or decay of a chemical constituent throughout the network.
- Perform Fire Flow Analyses on the network system to determine how the system behaves under extreme conditions.
- Uses a Scenario Management feature to mix and match a variety of "what if" alternatives on the network system. The user can create sets of hydraulic, physical property, operational, initial setting, fire flow, cost, and water quality alternatives. The user can also create and run any number of scenarios by mixing and matching alternatives, then view and compare the results quickly and easily with the model's flexible scenario framework.

The theoretical basis for the WaterCAD model is thoroughly derived in the user's manual.

5.1 Basic Assumptions[3]

It is not necessary to model every pipe and junction in the distribution system. The basic objective of the model is to understand the general flow and pressures patterns throughout the system. Therefore, for the Elkhart model, in general only pipes of 12-inch diameter and larger were modeled. For areas where smaller pipes exist to loop the system and improve the connectivity efficiency, these pipes were included in the model.

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[1] The Elkhart model uses 667 pipe segments and 478 junctions.
[2] *User's Guide: WaterCAD v4.1 for Windows*; Haestad Methods, Inc., ©1986
[3] An overview of the modeling assumptions is outlined in the technical memorandum *Future Conditions Modeling Assumptions*, Malcolm Pirnie, Inc., Indianapolis, Indiana, in Appendix C.

Secondly, a simplifying assumption was made related to the characteristic of the source water supplies applied to the model. Because the intent of this modeling effort was to evaluate the performance of the distribution network, each well field was treated as an "infinite" source of water supply. This assumption ensured that water quantity did not limit the system. Deficiencies in area pressures could then correlated directly to the capability of the piping network to convey the supply.

Thirdly, a conservative approach was taken to simulating fire-fighting conditions. Evaluating the system's performance during fires assumed a 5 MGD fire occurring at the Elkhart General Hospital, simultaneous with a 2 MGD fire occurring in the vicinity of evaluation. Both fire events were assumed to occurring for a period of 2 hours and in the evening between 8 PM and 10 PM, corresponding to the peak of the diurnal demand.

Finally, the model assumes that operation of the West Booster Station occurs only when there is a substantial fire-fighting event in the western perimeters (specifically in the Conrail area) of the distribution network. A "substantial" fire means that at least two hydrants are being used simultaneously to fight the fire. Operation of the South Booster Station is for providing pressure increases to the Bent Oak Country Club & Estates development in the southern-most portion of the distribution network.

5.2 Model Calibration Methodology

Chapter 4 of this report outlined the methodology used in establishing the water usage demands for input into the hydraulic model. This section describes the methodology used to calibrate the model for use in this planning effort. Calibrations were set by simulating the system's response during the 24-hour duration of the maximum day (June 9, 1999), and compared with the actual hourly pumping records for that day. About 98% of the allocated demand was due to residential. The diurnal pattern associated with the residential allocation was derived from the actual known data from the maximum day record. The remaining 2% was allocated to commercial uses, and the diurnal pattern associated with those uses taken from a standard, or more generic pattern developed for the water industry. Calibrating the model was based on pressure at the three wellfield pump stations, and at the three elevated storage tanks (Benham, Riverview, and South).

Two types of calibration simulations were run for the 24-hour maximum day: 1) system inflows based on point inputs at the wellfield pump stations, and 2) inflows based on actual modeled high service pump inputs. The summary of the results for these simulations is given in **Table 5.2.1**. The technical paper provided in Appendix D provides a more complete description of the calibrations simulations.[4] The complete set of simulation results is provided in the technical memorandum[5] in Appendix C.

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[4] *Utilizing GIS in Developing Realistic Demand Distributions to Support WaterCAD Modeling in Water Supply Master Planning*, July 2001

[5] *City of Elkhart Water Distribution System Model Information Review and Calibration*, November 2000, Malcolm Pirnie, Inc., Indianapolis, Indiana

It is understood that this degree of calibration is not intended to be the calibration that will be the basis for the water distribution model once preliminary and final design programs for system improvements begin. For these activities, a much more detailed calibration will be necessary, which must include a series of flow and pressure tests in the field as well as acquiring more detailed data at wellfield pumping stations. But for purposes of this master planning effort, the level of calibration detail developed for this model is deemed sufficient.

Table 5.2.1 Error Differences Between Actual Conditions and Modeled Simulations

	System Demand (MGD)			Northwest Wellfield (Pressure, psi)			N. Main St. Wellfield (Pressure, psi)			South Wellfield (Pressure, psi)		
	Avg Error	Max Error	Min Error	Avg Error	Max Error	Min Error	Avg Error	Max Error	Min Error	Avg Error	Max Error	Min Error
Point Inflow	-0.19	-7.73	+0.10	-4.11	-18.14	+0.38	-0.36	-17.42	+0.10	-1.57	-10.74	+0.11
Pumped Inflow	-0.19	-7.73	+0.10	-1.69	-11.06	-0.60	+3.48	+13.46	+1.25	+1.24	+13.05	-0.73

5.3 Model Limitations

The application of the WaterCAD® for the Elkhart system posed minimal limitations. The model's "continuous simulation" capability is not a true continuous simulation. Rather, each hour of the 24-hour continuous simulation mode is actually an independent steady-state result. The output from each hour becomes the input for the subsequent hour. In the end, 24 sets of steady-state results are linked together to reflect the full 24-hour diurnal simulation. Using this algorithmic technique dramatically reduces computer processing time.

The other limitation found with the model was in the graphical presentation of the modeled components. In those areas where pipe network density is significant, labeling the components becomes cumbersome and difficult because of the limits placed on the user in manipulating the labels. To some extent this limitation is due to the fact that the WaterCAD is a graphics engine in and of itself

5.4 Model Interface with GIS

Interfacing the WaterCAD® input and output data with Arcview GIS®[6] is a powerful tool. Within WaterCAD® tools are available, though quite limited, to allow the user to develop a pseudo-GIS platform. Utilizing the Arcview interface, however, provides the user with a variety of graphic and database tools to more effectively present and communicate the modeling effort. But in its current format this interface is not trivial. It involves a relatively complicated sequence. **Figure 5.4.1** interprets this process. When data is created in the WaterCAD® model, the initial step is to

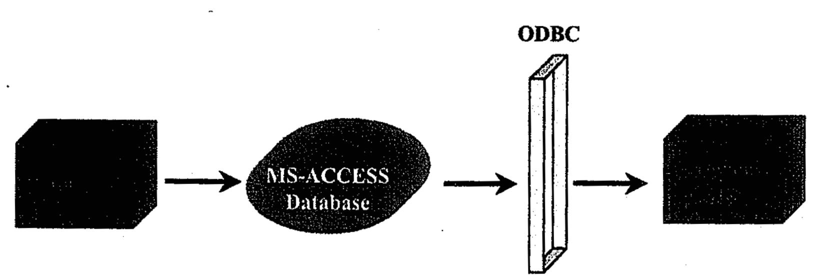


Figure 5.4.1

[6] Environmental Systems Research Institute (ESRI), Redlands, CA

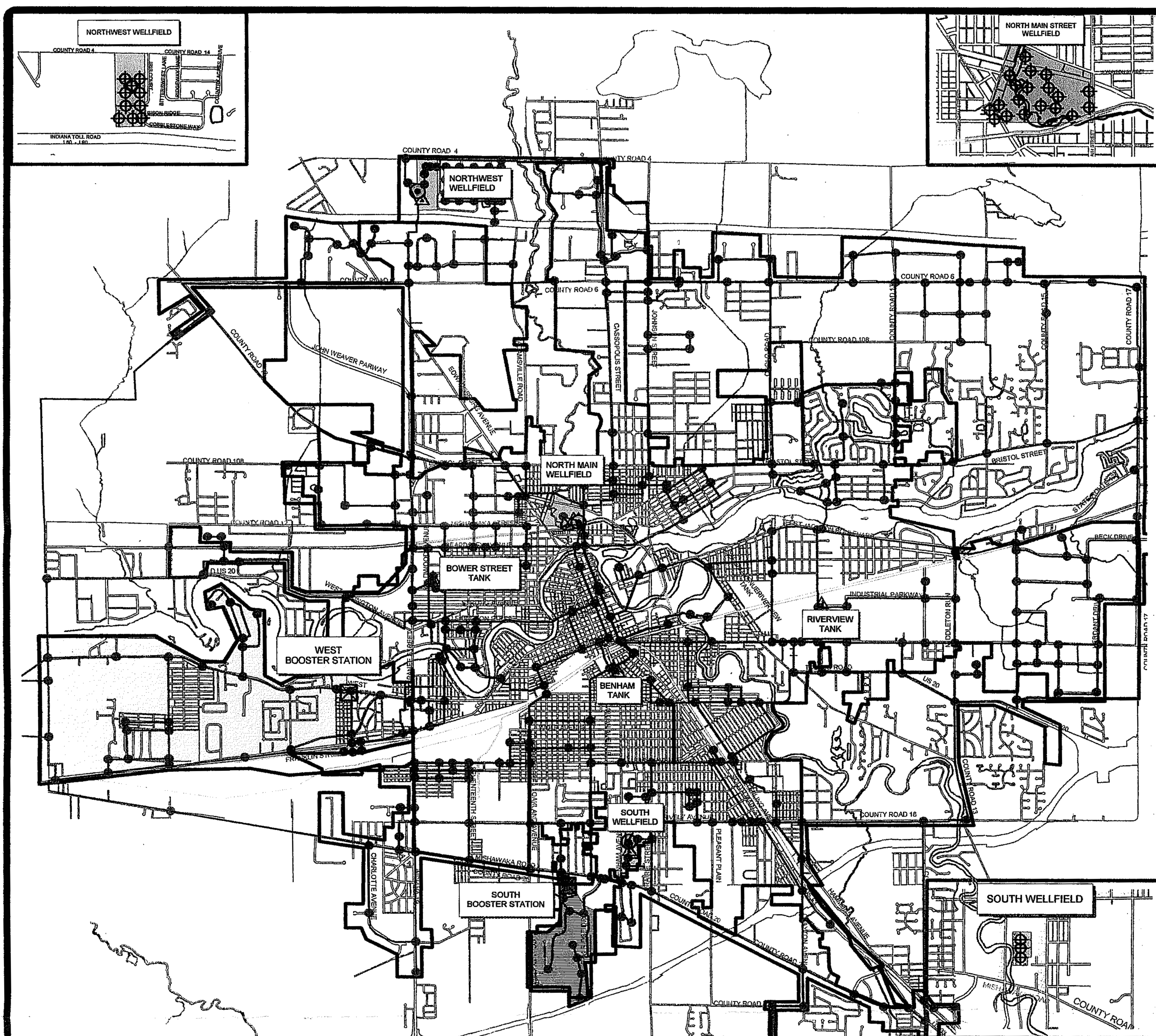
export that information into a database platform. For the Elkhart model, this platform was the Microsoft ACCESS package. In order for the Arcview to retrieve and map this data, a "gate" is first created through Arcview known as an "Open Data Base Connection" (ODBC). With the ODBC in place, data from the MS-ACCESS can be read into Arcview through this gate. Once this ODBC is created and operable, it does not need to be recreated with each new set of WaterCAD® data. In other words, once the gate is opened, it remains open and data can pass through with each WaterCAD® change. But the user must be operating from within the Arcview project file's active View in order for the data to be updated in Arcview. Though logical in its construction, the process can be quite labor intensive. A more detailed description of this procedure is given in the technical memorandum in Appendix C.[7]

Figure 5.4.2 is an example of a layout created in Arcview with data exported from WaterCAD through the ODBC gate. The reader is encouraged to compare this Arcview output layout with that derived from the WaterCAD graphics engine which is provided as part of Appendix C.

[7] *Conversion of WaterCAD Model Results to GIS Importation of GIS Data to WaterCAD*; December 2000; Malcolm Pirnie, Inc., Indianapolis, Indiana

Water Distribution Sytem System Model

City of Elkhart Public Works & Utilities
Water Distribution System Model



Legend

Model Pipes
Model Nodes
1999 Water Service Area - 23,900 Acres
City Limits

Treatment and Storage
BoosterStation
Tank
Treatment Facility

Pressure Zones
South Pressure Zone
West Pressure Zone

No Scale

Figure 5.4.2

Chapter 6 Results

The objective of the WaterCAD® distribution model was to identify the areas within the network that are deficient in pressure as a result of demands placed on the existing system in PY2005 and PY2015. With these areas identified, improvements to the system pressure such as main extensions, looped lines, increases in storage, and new sources of inflow could be modeled to correct the deficiency. The range of 35-40 psi was used as the minimum threshold for defining a system deficiency.

In general, the existing system network is deficient in the east and southeastern perimeter of the city. This fact is especially evident when analyzed under the 2015 demand and fire fighting conditions. The results of the WaterCAD modeling efforts call for improvements in the water distribution network. These provide significant enhancements to the system's ability to *move* and *store* the appropriate quantities at the appropriate pressures throughout the system to meet expected demand and fire protection. Improvements are proposed in four elements: 1) large transmission main extensions to complete the perimeter conveyance loop around the city's service area, 2) loop extensions to improve conveyance efficiency, 3) water storage to improve reserve and fire protection capacity, and 4) source of supply and treatment to provide for future projected water quantity demand.

6.1 Existing Conditions Results

Figure 6.6.1 is an output directly from the WaterCAD® model run of the existing distribution network configuration under existing demands (with the aid of a presentation post-processing software package).[1] The system pressures are represented by "pressure contours."[2] Under current conditions, the model indicates the system is meeting its demand obligations in all serviced areas with the exception of the extreme southeastern-most extension. Zones of high pressure (greater than 70 psi) are indicated in the vicinities surrounding the existing wellfield pumping stations, and at the South Booster station that elevates pressures to serve the Bent Oak development. A West Booster station also exists located along CR 16 west of Nappanee St (SR 19) but is utilized only for fire protection. Though the modeling indicates that the system is sufficient under current demand conditions, applying projected demands on this existing configuration proves problematic. This is outlined next.

6.2 Planning Year 2005 Results

For Planning Year 2005, two key transmission extensions and expansions at both Northwest Wellfield and South Wellfield are essential to correcting short-term deficiencies. The recommended improvements are as follows and illustrated in **Figure 6.2.1**:

[1] The output from WaterCAD was imported into a post-processor graphics package (Arcview from ESRI) to improve clarity of the WaterCAD output which is limited with regard to presentation style.
[2] These pressure contour outputs are the root data files for the Spatial Analyst 2-D surface models developed in the GIS. The Spatial Analysts file outputs are the colored maps displayed in the Executive Summary of this report and correspond directly with these WaterCAD® outputs.

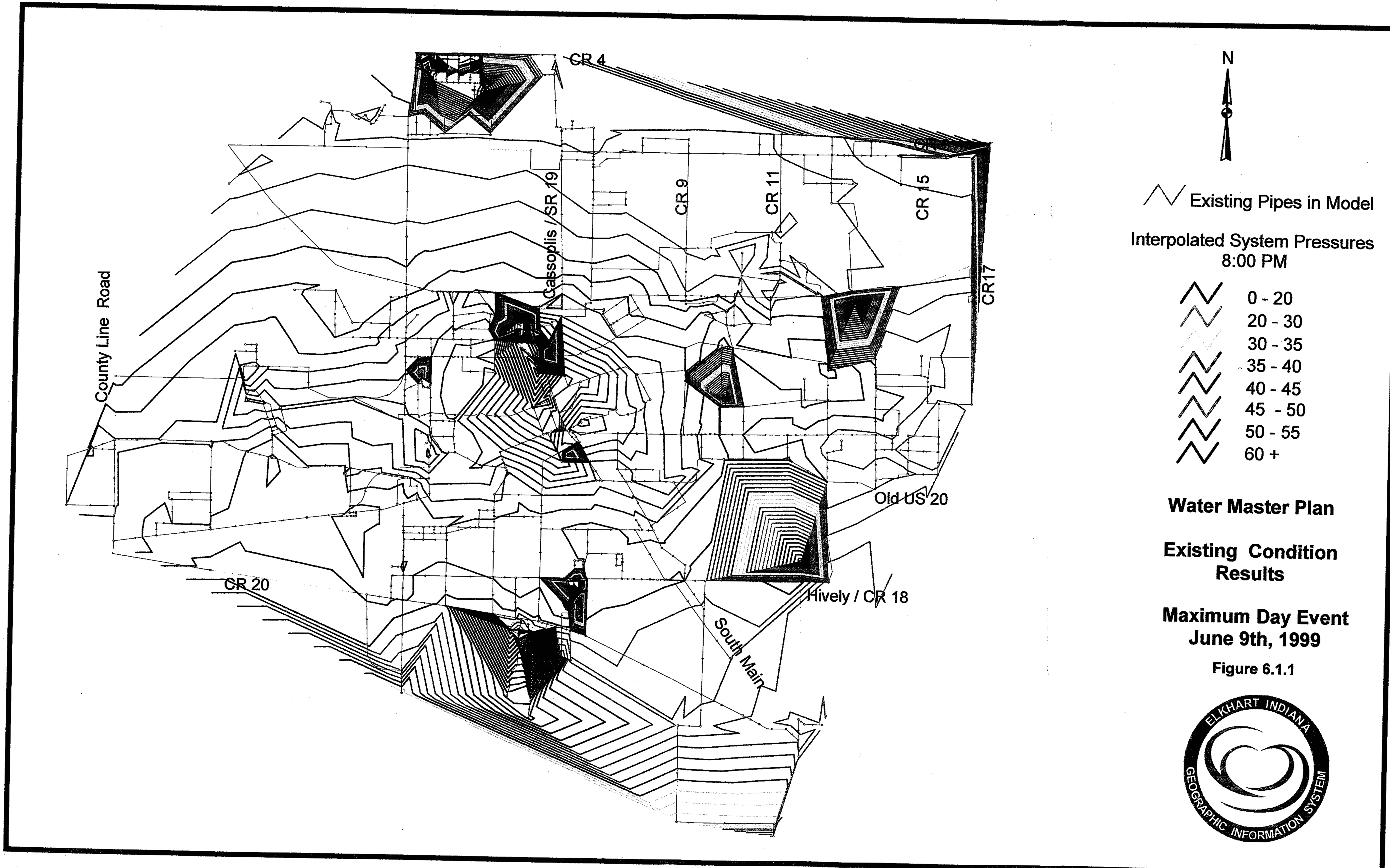
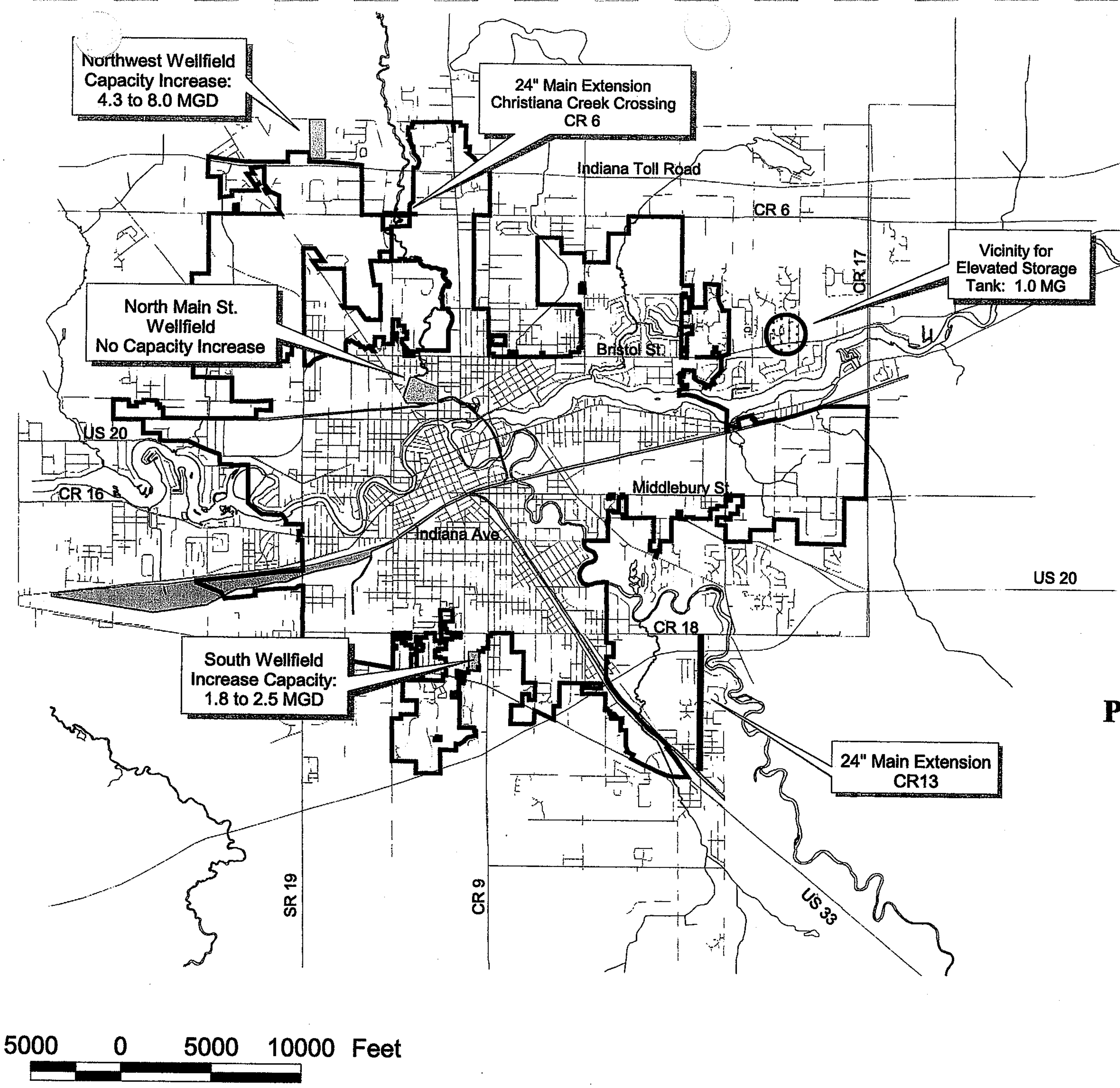

CR 4
CR 6
Cassoplis / SR 19
CR 9
CR 11
CR 15
CR17
County Line Road
Old US 20
CR 20
Hively / CR 18
South Main
N
Existing Pipes in Model
Interpolated System Pressures
8:00 PM
0 - 20
20 - 30
30 - 35
35 - 40
40 - 45
45 - 50
50 - 55
60 +
Water Master Plan
Existing Condition Results
Maximum Day Event
June 9th, 1999
ELKHART INDIANA
GEOGRAPHIC INFORMATION SYSTEM

Figure 6.1.1



Water Master Plan

Phase I Improvements Planning Year 2005

Figure 6.2.1

ELKHART INDIANA GEOGRAPHIC INFORMATION SYSTEM

a) 24” connection along CR6 between the City Limits on the east and Adamsville Road on the west; includes crossing under Christiana Creek.

b) 24” main extension along CR 13 looping the distribution system between CR 18 on the north and CR 45 on the south.

c) Increase firm supply capacity at Northwest Wellfield from 4.3 to 8.0 MGD by the additional of 4 new production wells at 750 gpm each. This increase in production requires an expansion to the existing water treatment plant (which was originally sized for a treatment capacity of 10 MGD).

d) Increase firm supply capacity at South Wellfield from 1.8 to 2.5 MGD by the replacement of Well No. 1 and with the addition of one new production well at 800 gpm.

e) Elevated Storage Tank with capacity of 1.0 MG located in the neighborhood vicinity of CR 10 and CR 15 in the City’s northeast quadrant.

With these improvements, the pressure deficiencies in the southern and southeastern portion of the distribution system are alleviated. The correction comes mostly through the increase in capacity at South Wellfield and the 24” looped connection in CR 13. Additionally, by completing the 24” loop connection along CR6 at Christiana Creek, relieves the constraints with conveying water efficiently from the Northwest Wellfield to areas on the City’s northeast corridor. The increase in elevated storage tank capacity primarily provides the needed reserve and fire protection capacity that is needed in this growing corridor.

Figures 6.2.2 illustrates the direct WaterCAD® model output for the existing distribution network operating under PY2005 demands and fire loads. **Figure 6.2.3** displays the system with Phase I improvements and operating under PY2005 demand and fire loads.

6.3 Planning Year 2015 Results

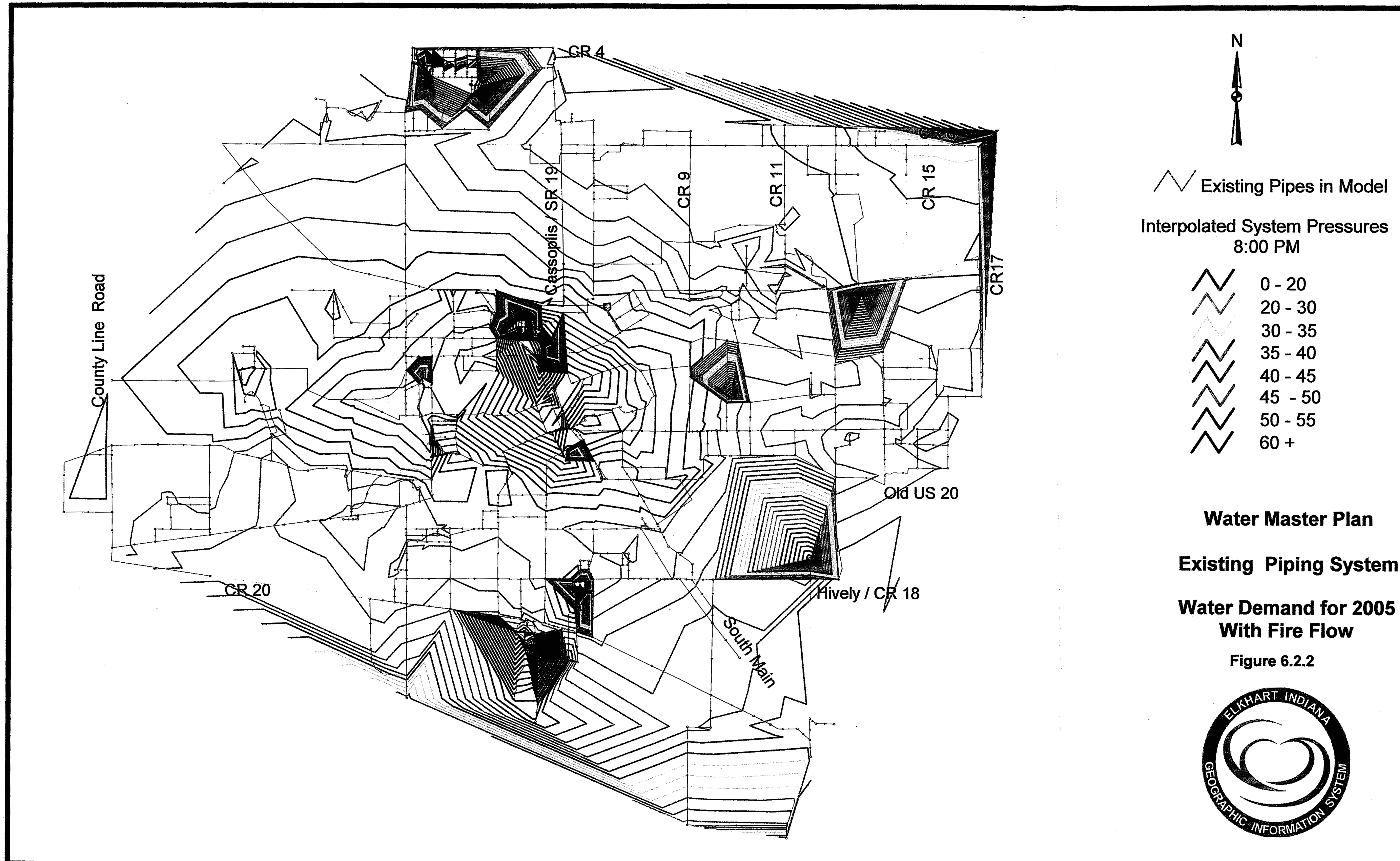
Results of the modeling of the PY2015 demand placed on the existing distribution network show substantial inadequacies in pressure and flow. The deficient pressure “front” migrates significantly westward from the eastern and northern perimeters of the service placing much of the city’s service area in performance jeopardy. The deficiencies are due to both network conveyance constraints and lack of adequate supply. To achieve acceptable mitigation of these deficiencies, a series of supply and network improvements are proposed. This assumes that all Phase I improvements are in place. These are as follows and illustrated in **Figure 6.3.1**:

a) 24” connection along CR 10 between Homeland Ave. on the west and CR 15 on the east

b) 24” connection along State Road 19[3] between Markle Ave. on the south and Lexington Ave. on the north. This connection also involves a crossing of the St. Joseph River near the Nappanee Street bridge.

c) 16” connection along CR 20 between County Line Rd on the west to Charlotte on the east.

[3] The actual route of this connection is dependent on future Phase II expansion of SR19 from Lusher Avenue north to SR 112.

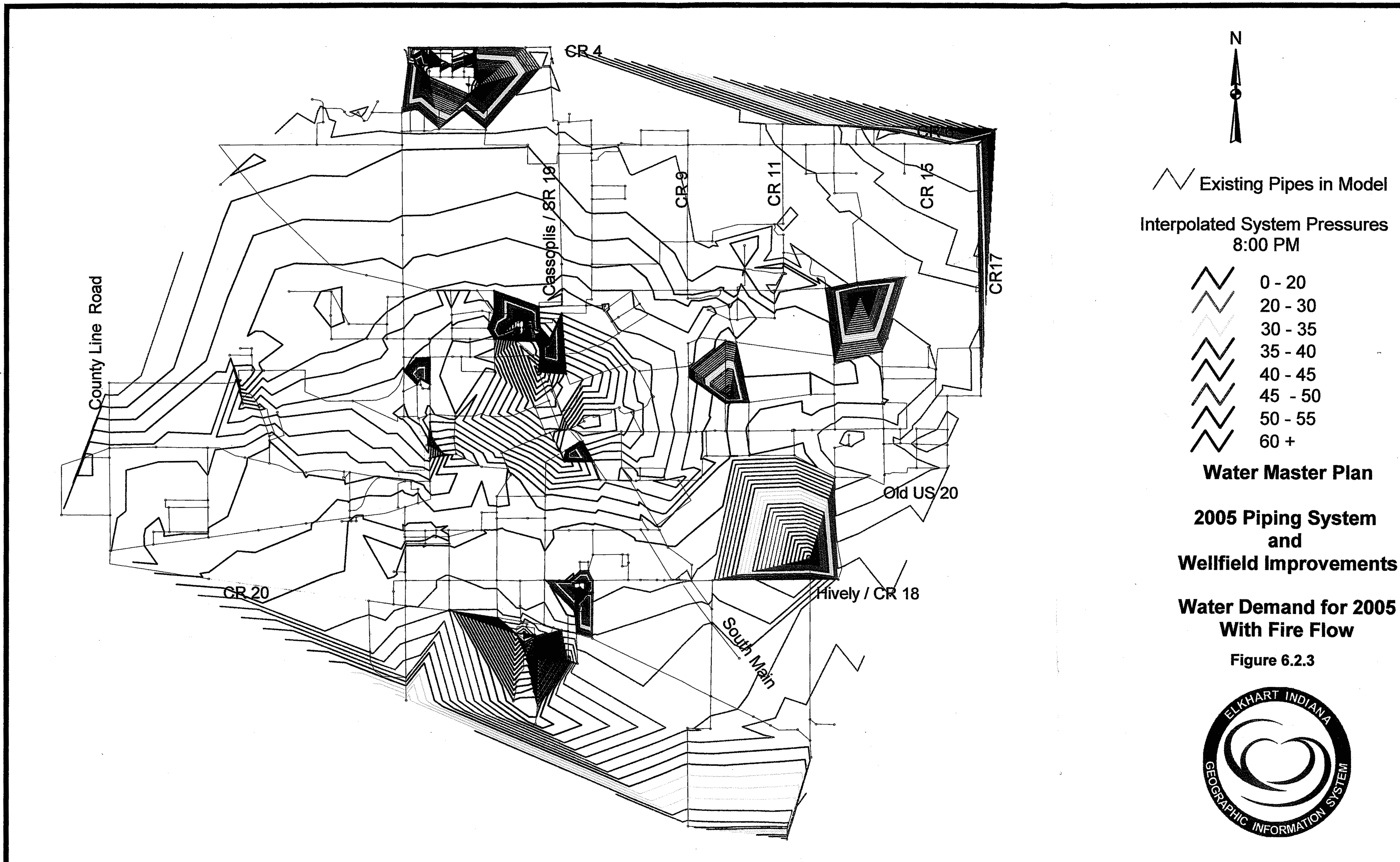


Water Master Plan

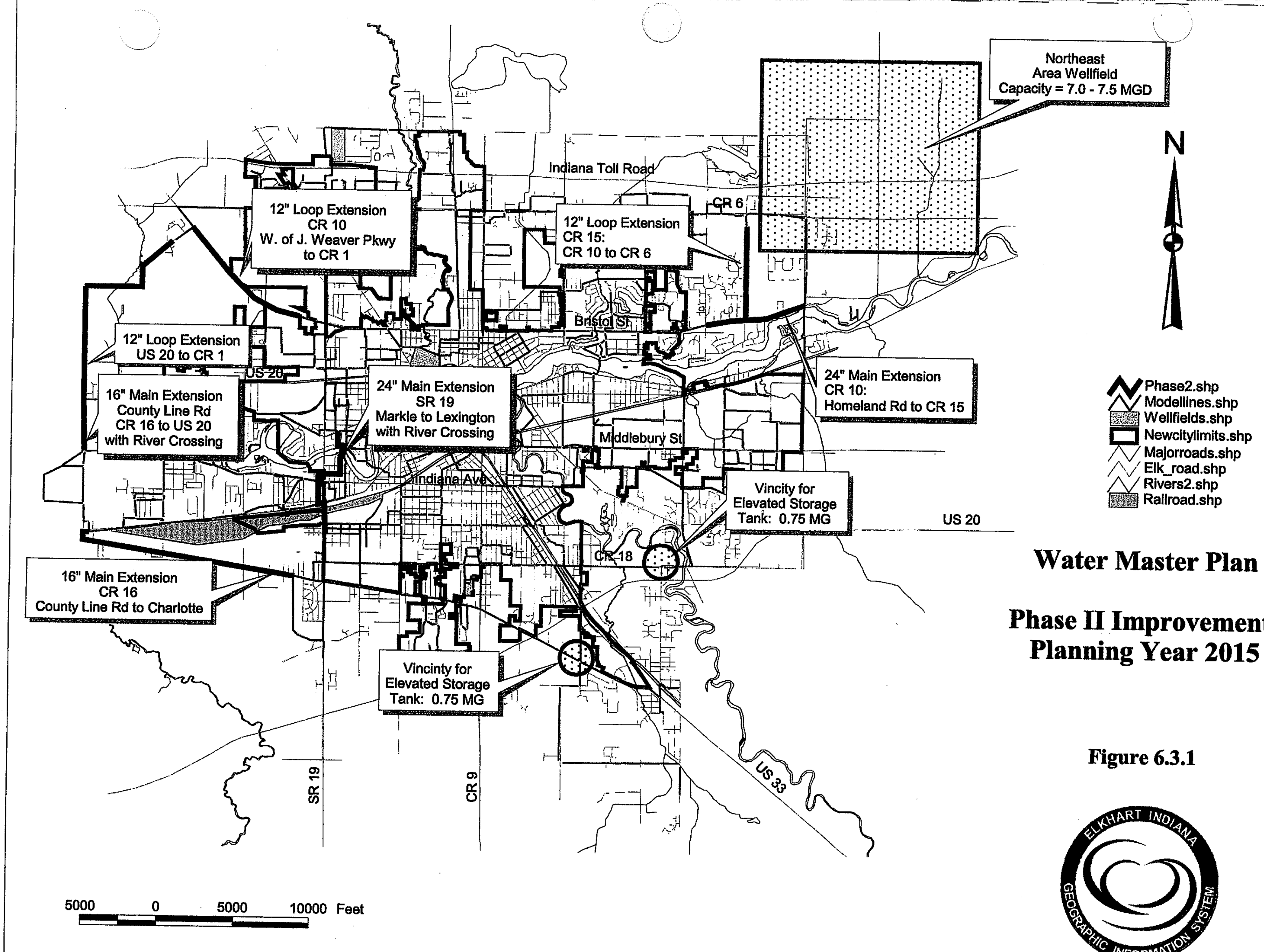
Existing Piping System

Water Demand for 2005 With Fire Flow

Figure 6.2.2



CR 4
Cassopolis / SR 19
CR 9
CR 11
CR 15
CR17
County Line Road
Old US 20
Hively / CR 18
CR 20
South Main
N
Existing Pipes in Model
Interpolated System Pressures
8:00 PM
0 - 20
20 - 30
30 - 35
35 - 40
40 - 45
45 - 50
50 - 55
60 +
Water Master Plan
2005 Piping System
and
Wellfield Improvements
Water Demand for 2005
With Fire Flow
Figure 6.2.3
ELKHART INDIANA
GEOGRAPHIC INFORMATION SYSTEM



Water Master Plan

Phase II Improvements
Planning Year 2015

Figure 6.3.1

ELKHART INDIANA GEOGRAPHIC INFORMATION SYSTEM

d) 16" connection along County Line Rd between CR 16 on the south to old US 20 on the north. This connection also involves a crossing of the St. Joseph River.

e) 12" loop connection along County Line Rd from old US 20 on the south to CR 1 on the north (connection near Cobus Lane) and includes a crossing of Cobus Creek.

f) 12" loop connection along CR 10 between CR 1 on the north to approximately 1200' west of John Weaver Parkway.

g) 12" loop connection along CR 15 between CR 10 at the south to approximately 1000' south of CR 6.

h) Elevated Storage Tank with capacity of 0.75 MG located in the neighborhood vicinity of Mishawaka Road (CR 20) and Clayton Ave. (CR 11) in the City's southeast quadrant.

i) Elevated Storage Tank with capacity of 0.75 MG located in the neighborhood vicinity of Hively Ave. (CR 18) and CR 13 in the City's southeast quadrant.

j) New production wellfield and water treatment facility[4] having a firm capacity of 5 to 6 MGD, located in the city's northeastern quadrant at a site to be determined.

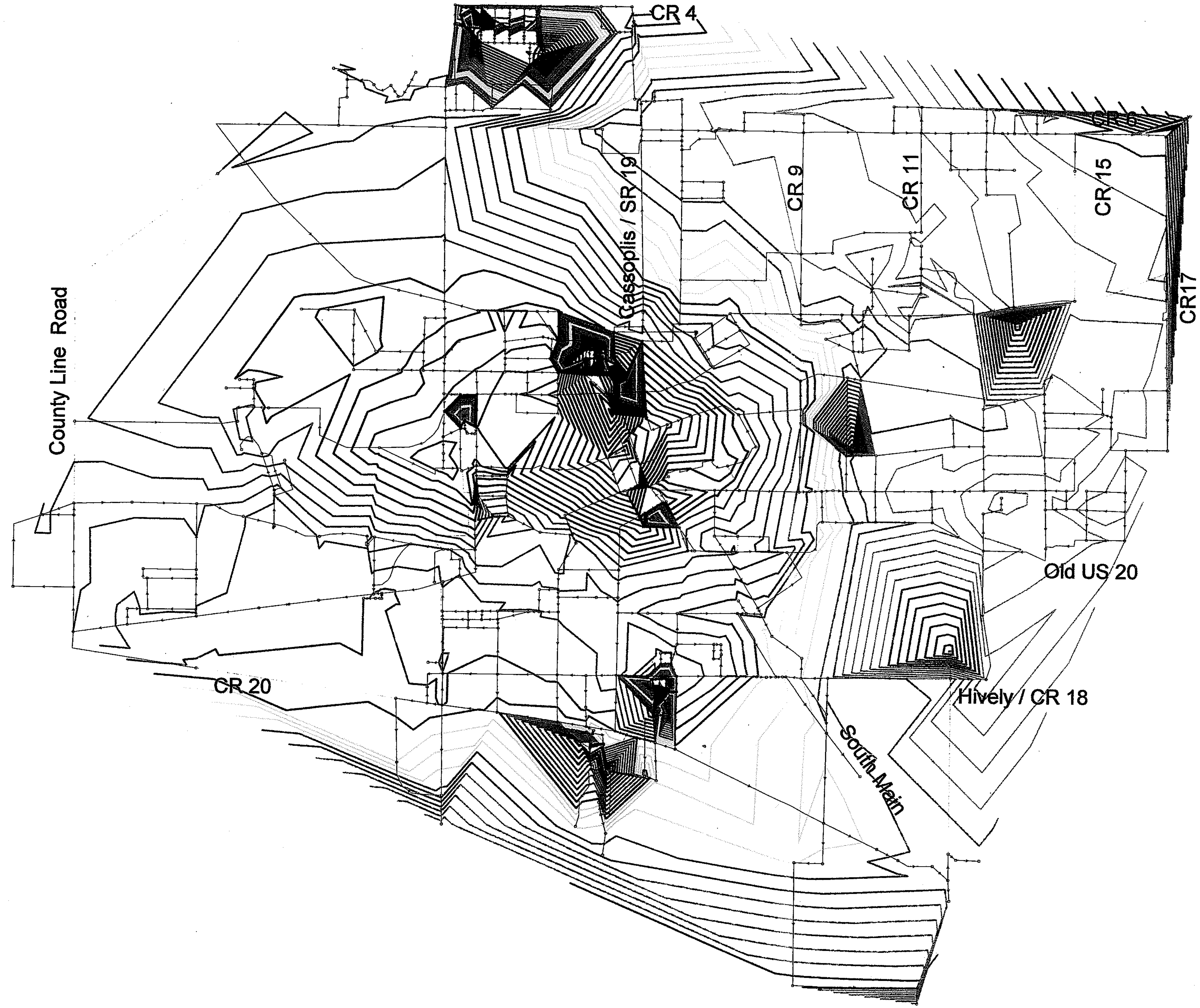
With these improvements, efficiencies in conveyance of water throughout the service area are drastically improved. Pressures along the perimeters of the service area are within acceptable standards (40-45 psi at southeastern extremes, and 50-55 psi along the eastern extremes).

It should be noted that under all improvement scenarios, the pressure conditions in the southern-most extreme perimeter of the distribution system remain inadequate. This area involves a dead-end 8" main along CR 26, extending eastward from CR 11 to CR 13. This line includes a dead-end extension southward along Circle R Drive. Because of the lack of adequate circulation in this area, the relatively small pipe size, and the higher ground elevations, pressures in the area improve only from 20 to 30 psi to between 30 and 35 psi despite the Phase I and Phase II improvements.

The number of customers being served off this 8" main is less than 50. There are no cost-effective alternatives to improve the pressure deficiencies in this area. It is recommended, then, that the City of Elkhart consider off-loading this short dead-end segment from its distribution system. The City of Goshen's water distribution system exists nearby and the pressures available through that system would likely be more favorable.

Figure 6.3.2 illustrates the deficiencies predicted by WaterCAD® in the existing distribution system when operated under PY2015 demands. **Figure 6.3.3** displays the WaterCAD® results of distribution system's response to the Phase II improvements operating under PY2015 demand and fire loads.

[4] A water treatment is necessary to achieve adequate iron and manganese removals and for disinfection. A likely design would include, as a minimu, oxidation followed by pressure filtration, fluoridation, and chlorination.



N

Existing Pipes in Model

Interpolated System Pressures
8:00 PM

0 - 20
20 - 30
30 - 35
35 - 40
40 - 45
45 - 50
50 - 55
60 +

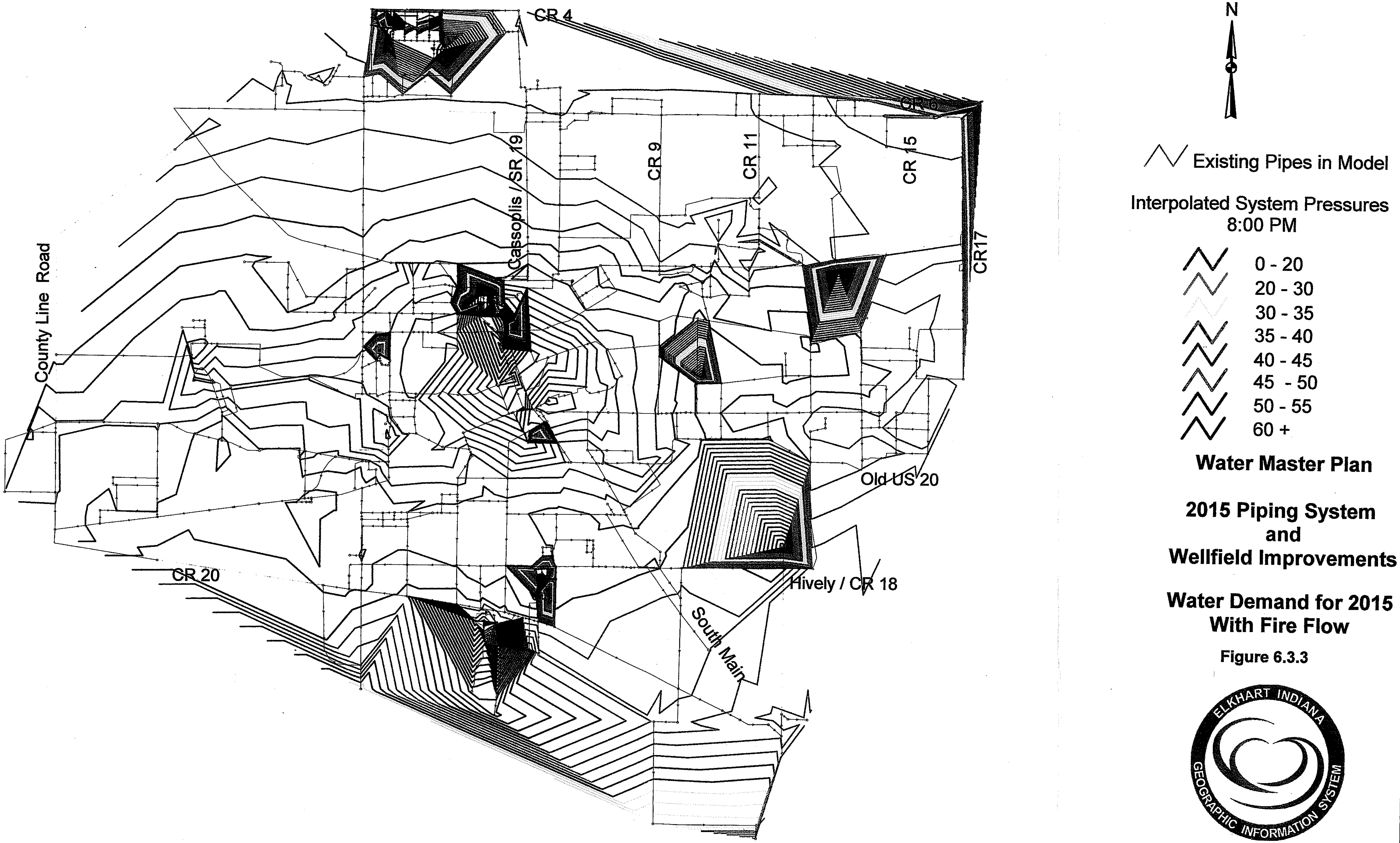
Water Master Plan

Existing Piping System

Water Demand for 2015
With Fire Flow

Figure 6.3.2

ELKHART INDIANA
GEOGRAPHIC INFORMATION SYSTEM



Water Master Plan

2015 Piping System and Wellfield Improvements

Water Demand for 2015 With Fire Flow

Figure 6.3.3

ELKHART INDIANA GEOGRAPHIC INFORMATION SYSTEM

Chapter 7
Capital Improvement Plan

7.1 Need for a Capital Improvement Plan

Planning for future infrastructure needs is a proactive step towards being a best-in-class utility. A major component of that planning involves projecting the order of magnitude costs that are likely to be incurred while implementing the plan. Timing the implementation proactively also may be difference between having means to pay for the improvements or not. In this section of the Water Master Plan, order of magnitude costs are presented for the improvements that are recommended through the 2015 planning year. Along with these costs is a proposed implementation schedule for the improvements. This schedule attempts to address the fiscal impacts of the improvements on the utility and "balance" against the utility's capacity to pay, through whatever funding mechanisms may be available and appropriate.

A logical approach is to schedule implementation of improvements on par with the rate of demand growth. If improvements are built ahead of the growth curve, there will likely be negative financial impacts because there will be infrastructure components "in the ground" without customers to receive benefit. On the other hand, deferring implementation to late in the planning horizon - though a fiscal advantage short-term (i.e., allows revenues to accumulate) - the utility runs a significant risk of not being able to meet the demand as it occurs. This could result in significant *economic* impact to the community due to opportunity costs losses attributable to businesses locate to neighboring communities where water demand is not in jeopardy. It follows then, that the fiscally responsible approach is to phase the improvements coincident with the demand curve. In this way, benefits are realized as the infrastructure improvements are built. The technical memorandum in Appendix C illustrates this point using the Elkhart system as a hypothetical example.[1]

Perhaps the more "visible" reason for developing a capital improvement program is to provide elected officials and public policy makers within the City of Elkhart with a fiscal roadmap for utility management. The operation and maintenance of the City of Elkhart's water utility is revenue-based. Costs of providing the services of supplying water and distributing it to the users are paid through user rates, fees and surcharges. With a capital improvement program in place, utility managers can devise informed proposals for rate and fee structures to ensure costs obligations are met. These proposals become the catalyst for public policy decision-making.

7.1 Cost Projections

Improvements for the master plan are broken out into two major phases: Planning Year 2005, and Planning Year 2015. Phase I improvements involve only improvements to the existing water supply and distribution system. Phase II includes additional improvements to the existing system and construction of a new wellfield facility. Descriptions of these phases are provided in Chapter 6 of this report. **Table 7.1.1** summarizes the improvements for the two phases and their respective total projected costs. **Tables 7.1.2** and **7.1.3** detail the cost components of each phase

[1] *The Next Step: Developing a Capital Improvements Plan*, October 2000, Malcolm Pirnie, Inc., Indianapolis, Indiana

and the assumptions for cost contingency. Applying contingency to a cost projection is standard practice. It is used to account for the level of uncertainty associated with future projection. Uncertainty occurs in differing degrees. Those associated with conceptual design (as in a master plan) are highest, ranging from 30% to 50%. As more information becomes available, and the master plan components move from "programs" to "projects" (preliminary design level), the contingency from 15% to 30%. At the final design stage, where projects are definitive, contingencies decrease to a range of 5% to 15%.

Table 7.1.1 Improvement Summary*

	New Wells at Existing Wellfields	Water Main Extensions	Treatment Expansion at Existing Wellfields	New Storage Reservoir	New Wellfield and Treatment Plant**
Phase I (2005)	2.07	2.20	7.00	2.00	-
Phase II (2015)	-	11.25	-	3.00	20.20
Totals	2.07	13.45	7.00	5.00	20.20

* values in million dollars
** includes cost for land acquisition

7.2 Recommended Schedule for Improvements

The projects outlined in Tables 7.1.2 and 7.1.3 require a proposed timetable for implementation. The schedule is designed to allow managers and public policy makers adequate time to investigate appropriate funding measures. Figure 7.2.1 provides the proposed master schedule for the projects. Several assumptions are built into this program.

1) The program assumes that rate of development and growth in demand will be in accordance with the demand schedule outlined in Chapter 4. This is more critical to the Phase II program. Since impacts associated with growth in demand are realized over a period of several years, it is prudent to complete the infrastructure needs outlined for Phase I in the time suggested (PY 2005 is just 4 years away). With these improvements in place, much of the current system's deficiencies will be resolved and the City of Elkhart will be in a good position to prepare for the longer term.

2) A critical review of the longer-term demand projections is recommended prior to implementation of Phase II. The demand growth patterns over the next 4-5 years are expected to follow the current patterns. However, should this rate significantly change in the near-term (either more or less rapid), program objectives for the long-term will likely need modification. For example, if the rate of growth decreases, then the proposed timetable for developing the funding for the Phase II projects could be delayed. On the other hand, if the rates increase, the prioritized schedule for the Phase II projects will need re-evaluation, with some moved up and others back. Most critical, would be the timetables related to the development of a new wellfield.

3) The majority of the funding for the major network extensions in Phase I is assumed to come from revenues generated directly from customer rates and charges. Primary

Table 7.1.2
CITY OF ELKHART
WATER SYSTEM MASTER PLAN

PHASE I: PROPOSED IMPROVEMENTS FOR 2005 (in 2001 Dollars)

Model Element	Project	Purpose	Size or Number	Units	Size	Units	Unit Cost (1)	Units	Subtotal ($)	Contingency (2,3,4,5)	Construction Cost ($)
	Main Improvements										
P-202	24" along CR 6 & CR 7	Close loop south of Northwest WF	24	inch	3,018	ft	146	$/ft	400,000	160,000	600,000
P-202	24" Christiana Creek Crossing	Close loop south of Northwest WF	24	inch	200	ft	400	$/ft	100,000	40,000	100,000
P-342	24" along CR13 from US 33 to Hively	Close loop at southeast corner of system	24	inch	7,639	ft	146	$/ft	1,100,000	440,000	1,500,000
	Storage Improvements										
T-5	1.0 MG elevated composite tank	Meet maximum-day demands for system	1	tank	1.0	MG	1,400,000	LS	1,400,000	630,000	2,000,000
	Water Supply and Treatment Improvements										
	Aquifer Testing and Preliminary Design -- Northwest Well Field and South Well Field		1	study			320,000	LS	320,000	80,000	400,000
	South Well Field Expansion (Upgrade Well 1, New Well)	Increase firm capacity from 1.8 MGD to 2.5 MGD	2	wells	0.8	mgd	150,000	EA	300,000	170,000	470,000
	Northwest Well Field Expansion	Increase firm capacity from 4.3 MGD to 8.0 MGD	5	wells	0.8	mgd	150,000	EA	750,000	410,000	1,200,000
	Northwest Well Field Supply Treatment Expansion	Increase treatment capacity from 5.0 MGD to 8.0 MGD	1	plant	3.0	mgd	1.5	$/gal	4,500,000	2,500,000	7,000,000
							Subtotal:		$ 8,900,000		
							Contingency Subtotal:			$ 4,400,000	
							Total for 2005:				$ 13,000,000

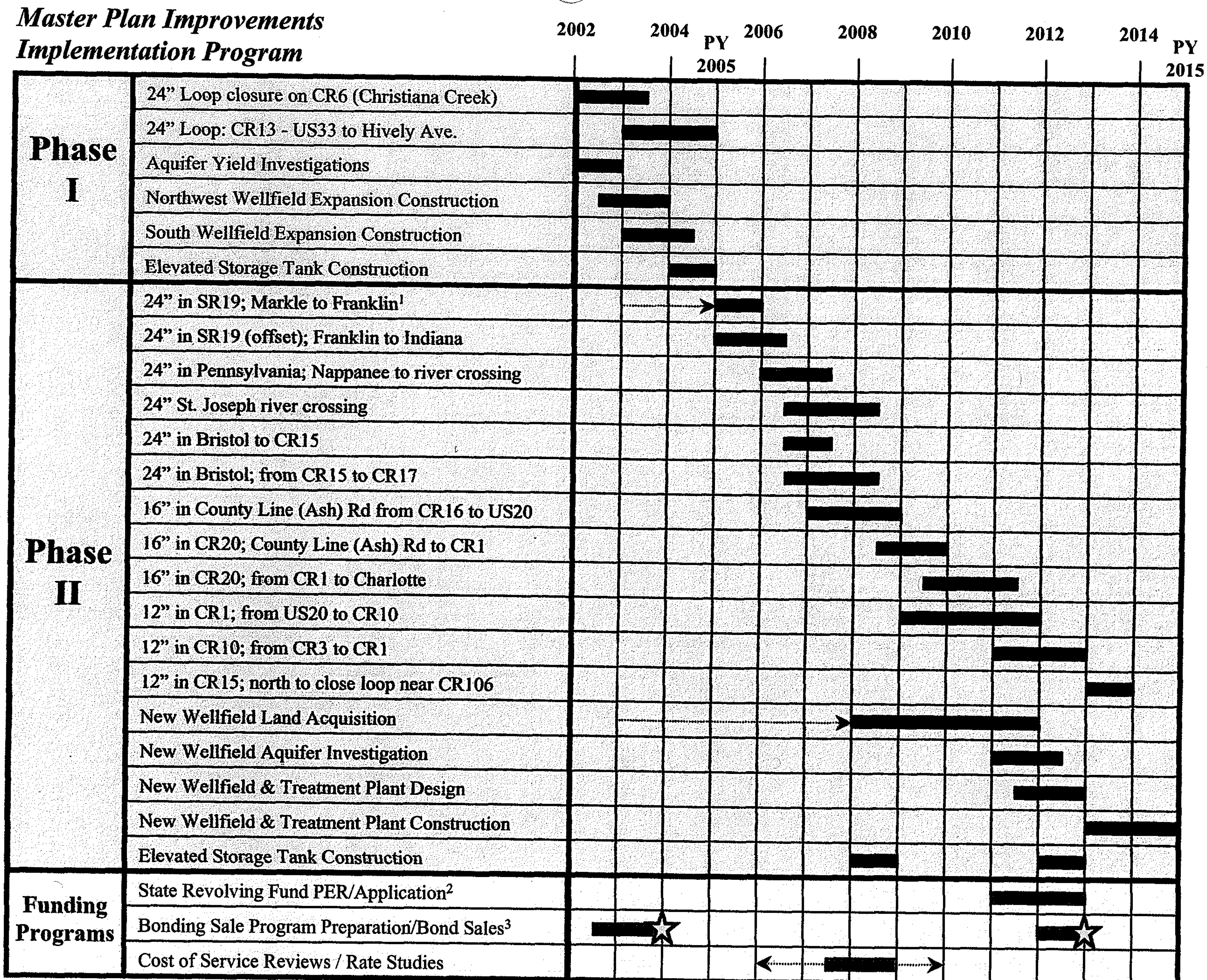
NOTES:
(1) Main costs include asphalt paving
(2) Contingency for Mains was calculated using 40%, which includes the following:
  Design, Legal, & Other Services (15%)
  Contingency (25%)
(3) Contingency for Storage was calculated using 45%, which includes the following:
  Design, Legal, & Other Services (15%)
  Contingency (30%)
(4) Contingency for Water Supply and Treatment was calculated using 55%, which includes the following:
  Design, Legal, & Other Services (15%)
  Contingency (30%)
  Electrical & Instrumentation (10%)
(5) Contigency for Aquifer Testing & Preliminary Design was calcuated using 25%

Table 7.1.3
CITY OF ELKHART
WATER SYSTEM MASTER PLAN

PHASE II: PROPOSED IMPROVEMENTS FOR 2015 (in 2001 Dollars)

Model Element	Project	Purpose	Size or Number	Units	Size	Units	Unit Cost (1)	Units	Subtotal ($)	Contingency (2,3,4)	Construction Cost ($)
	Main Improvements										
P-343	24" along Nappannee from Markle to Franklin	Extend transmission main along Nappanee	24	inch	2,243	ft	146	$/ft	330,000	130,000	460,000
P-344	24" along (offset) Nappannee from Franklin to Indiana	Extend transmission main along Nappanee	24	inch	1,700	ft	146	$/ft	250,000	100,000	350,000
P-382	24" Along Pennsylvania from Nappannee to River Crossing	Extend transmission main across St. Joe	24	inch	3,132	ft	146	$/ft	500,000	200,000	700,000
P-383	24" River Crossing	Extend transmission main across St. Joe	24	inch	500	ft	400	$/ft	200,000	80,000	300,000
P-383	24" River Crossing to Lexington & Wildwood	Extend transmission main across St. Joe	24	inch	2,016	ft	146	$/ft	290,000	120,000	410,000
P-590	16" Along west side of system	Close loop at west side of system	16	inch	3,591	ft	117	$/ft	420,000	170,000	590,000
P-800	12" CR 15 North	Close loop at northeast corner of system	12	inch	5,690	ft	84	$/ft	480,000	190,000	670,000
P-801	24" along Bristol to CR 15	Extend transmission main along Bristol	24	inch	2,692	ft	146	$/ft	390,000	160,000	550,000
P-802	24" along Bristol from CR 15 to CR 17	Extend transmission main along Bristol	24	inch	4,228	ft	146	$/ft	620,000	250,000	870,000
P-803	16" along CR 20 from County Line to CR 1	Extend transmission main along CR 20	16	inch	6,236	ft	117	$/ft	730,000	290,000	1,000,000
P-804	16" along CR 20 from CR 1 to Charlotte	Extend transmission main along CR 21	16	inch	8,871	ft	117	$/ft	1,000,000	400,000	1,400,000
P-805	12" along CR 1 from US 20 to CR 10	Extend transmission main along CR 1	12	inch	14,027	ft	84	$/ft	1,200,000	480,000	1,700,000
P-806	12" along CR 10 from CR 3 to CR 1	Extend transmission main along CR 10	12	inch	9,406	ft	84	$/ft	790,000	320,000	1,100,000
	Storage Improvements										
T-6	0.75 MG elevated steel tank	Meet maximum-day demands for system	1	tank	0.75	MG	1,045,000	LS	1,000,000	450,000	1,500,000
T-7	0.75 MG elevated steel tank	Meet maximum-day demands for system	1	tank	0.75	MG	995,000	LS	1,000,000	450,000	1,500,000
	Water Supply and Treatment Improvements										
	Northeast Well Field Land acquisition (if needed)	Allow for construction of Northeast Well Field	50	acres			30,000	$/acre	1,500,000		1,500,000
	Northeast Well Field Installation	Meet projected 2015 maximum day demands	7	wells	7.5	mgd	150,000	EA	1,100,000	610,000	1,700,000
	Northeast Well Field Treatment Facilities	Treat supplied water from new well field	1	wells	7.5	mgd	1.5	$/gal	11,000,000	6,100,000	17,000,000
								Subtotal:	$ 23,000,000		
								Contingency Subtotal:		$ 11,000,000	
								Total for 2015:			$ 34,000,000

NOTES:
(1) Main costs include asphalt paving
(2) Contingency for Mains was calculated using 40%, which includes the following:
  Design, Legal, & Other Services (15%)
  Contingency (25%)
(3) Contingency for Storage was calculated using 45%, which includes the following:
  Design, Legal, & Other Services (15%)
  Contingency (30%)
(4) Contingency for Water Supply and Treatment was calculated using 55%, which includes the following:
  Design, Legal, & Other Services (15%)
  Contingency (30%)
  Electrical & Instrumentation (10%)



1) Schedule dependent upon InDOT program   2) Preliminary Engineering Report   3) Assumes attractive bond rating exists

Figure 7.2.1

funding for the wellfield expansions at Northwest and South is assumed to be through a revenue bond program. This bond program could also include source funding for the major transmission main (24" diameter) extensions proposed for construction through 2008 under the Phase II program. This bond program, if utilized, would need to begin no later than July 2002, with sale expected in the 4th quarter of 2003. A second bond program is proposed to support the new wellfield development near the end of Phase II. This bond program would be drawn up during the year 2012, with bond sales at the end of 2012 in time to finance the construction of the wellfield between 2013 and 2015.

4) As an alternative to bonding, the City of Elkhart may want to pursue use of supplemental funding mechanisms such as the Economic Development Income Tax (EDIT) program, or through special programs that coordinate with Elkhart County, such as County Option Income Tax (COIT), or County Adjusted Gross Income Tax (CAGIT) funds. Though Tax Increment Financing (TIF) districts are also an option, these types of mechanisms tend to carry greater risk because of their dependence on the speculation of growth.

5) An alternative financing mechanism now available to publicly owned utility facilities is the State Revolving Fund (SRF). This is a low-interest loan program administered by the State of Indiana. Funds through this program are distributed based on community need, and the interest rates awarded based on a number of socio-economic factors including population, median household income, industrial base, unemployment trends, tax collection rates, and so forth. A major qualifying component within the SRF program is the Preliminary Engineering Report. This document is a detailed engineering overview of the improvements needed including a verification of the assessed need, preliminary engineering designs, cost estimates, and construction schedules. Timetables for these loan programs are typically 20 years. It must be understood, however, that new allocations to the SRF program must be legislated by Congress. It is prudent, therefore, to count on the SRF only for more immediate rather than future funding needs. Consequently, funding Phase I projects through the SRF program may be more attractive than bonding, depending on the interest rates that could be secured.

6) Obvious secure funding mechanisms are the actual water rates and charges. Despite increases of 19% in water rates in each of 2002 and 2003, debt service commitments resulting from any of the public bonding or State loan programs described above will affect rates. Prior to any rate increase proposal, a full "cost of service" study is strongly recommended. According to the implementation program outlined in Figure 7.2.1, this cost of service study should commence no later than 2005. Adequate time must be provided for negotiations with the Indiana Utility Regulatory Commission and Elkhart's rate payers prior to the increases. Public officials are always encouraged to consider the impacts to rates early in the implementation program.

7) The overall implementation schedule for Phase II improvements assumes that the major transmission mains (24") are constructed first. The system's model indicates that with the transmission backbone in place, water can be moved throughout the system with better efficiency. Conveyance efficiency improves water service to all customers, not just those at the outer perimeter of the service area.

8) It is assumed that no land acquisition is required for the installation of transmission mains in either of Phase I or Phase II. If it turns out that additional rights-of-way must be secured from private properties, projects will likely be delayed along with increases in project costs. In addition, the proposed schedule assumes that negotiations with the Indiana Department of Transportation for permission to work within state-owned right-of-ways, CRX for crossings of existing railroad right-of-ways, and the Indiana Department of Natural Resources for crossings of rivers are successful within timeframes typical of these processes. If negotiations are stalled, the implementation schedule outlined in Figure 7.2.1 would need to be revisited and revised accordingly. It should be noted that the contingencies applied to the cost estimates in Tables 7.1.2 and 7.1.3 are designed to account for some of this uncertainty. However, contingencies cannot account for the time delays.

7.3 Implementation Obstacles

Without a doubt, the predominant component potentially impeding the progress of this master infrastructure program for water supply and distribution is that of secured, "affordable" financing. Funding has many variables and detailed outlines of the various mechanisms, and the combinations thereof, are beyond the scope of this report. But financial issues are not the only potential obstacles. This section briefly addresses other issues often encountered in the implementation of major infrastructure programs that can delay, derail, or even stop a program.

7.3.1 Regulatory Issues

The City of Elkhart's water utility is under the regulatory eye of the Indiana Utility Regulatory Commission (IURC). All issues relating to customer rates are developed and implemented to pay for the costs of owning and operating the water utility must be reviewed and approved by this commission. In the recent years, a consumer advocacy organization known as the Office of Utility Consumer Council (OUCC) has been broadening its participation in the overall rate review process. Though designed to be an advocate for the water rate payer, unfortunately, involvement of this organization adds substantial time and expense to components such as cost of service studies and rate increase proposals.

The City of Elkhart has considered the option of opting out of the IURC's regulatory framework. This option should continue to be seriously considered, but with the awareness that time required and the logistics to do so are significant.

7.3.2 Land Speculation

A significant aspect of the Phase II program is a new wellfield. The area of land needed to provide the quantities of water described in this master plan is significant, on the order of 50-80 acres of contiguous, undeveloped land. Preferably, the City of Elkhart Water Utility would be best served by locating this in the northeastern quadrant, an area of significant anticipated growth, and which is anticipated to pose the bulk of the projected demand increases.

Additionally, locating a facility in this area provides direct access to the existing and proposed transmission infrastructure networks.

Land values in this vicinity are already on the increase due to long-range development proposals now in place for the area. Should the City not be able to secure land in this vicinity, it will be forced to move still further out from existing infrastructure placing additional cost burden on the new facility. It is recommended that the City of Elkhart Water Utility begin immediate investigations into potentially suitable land sites in this northeastern quadrant (4-6 square-mile area) in the vicinity of CR17 and the Indiana Toll Road. The time for identifying potential properties is now.

7.3.3 Public Participation

There is an adage that states: "Include me in your process at the beginning, and I become your partner; include me at the end, and I become your judge." In other words, if the public becomes an obstacle to implementation, it is likely that they were not adequately informed. In today's political and economic environment, to be informed means to be *involved* in the process. Though the effort of involving the public in the planning and decision-making processes from the outset can be significant, it is the best approach. In order for the public (rate-payer) to be supportive (financially) of the infrastructure improvements for the long-term, they must be convinced of the benefits they will receive, both individually and collectively, as a result of the improvements. Bringing the public along in the process must be a commitment that begins at the City's administrative levels, and continues down through the staff ranks.

It is recommended that the City of Elkhart organizes a citizen's advisory committee (CAC) consisting of, but not limited to, the following representatives:

a) local small business owners
b) large business owners
c) rate payers representing each township in the city limits
d) rate payers representing users outside the city limits
e) local developers
f) City council and Public Works Board members
g) City Public Relations staff
h) City planning staff
i) County planning staff
j) Local media

The success of this committee is the degree of "ownership" the group takes in the program. It is recommended that subcommittees be set up to formulate the various public policy issues, i.e., funding strategies, regulatory strategies, political strategies, economic development strategies, etc. If a CAC framework is to be pursued, it should be formed immediately and meet quarterly beginning in the 3rd quarter of 2002. Initial meetings would overview the Phase I and Phase II program. In subsequent meetings, each subcommittee would present their findings. Without a doubt, the biggest obstacle in establishing the CAC format is getting the necessary members to make the commitment to actively participate.

7.4 Requirements for Plan Review

Projecting into the future for any major infrastructure investment requires a critical review of that projection at strategic milestone points along the way so that sagacious adjustments can be made if necessary. As described in Chapter 4, projections of water demand through Planning Year 2015 are based on Elkhart's near-term historical trends in water usage. The demand projections have a significant influence on Phase II's need for the new wellfield, an obvious weighty contributor to the overall cost for the Phase II program.

It is strongly recommended that the City of Elkhart Water Utility review the demand projections at the completion of Phase I. This review should be completed no later than 2007. The review should evaluate the trends in demand growth from 1999 through 2005 and re-evaluate the appropriateness of the statistical models used to project the data. If it is found that rate of change is either less of greater than that projected under this edition of the master plan, it will necessitate a revision either to the scope of the program or to the timetable of the existing program.

Section 8
Appendix A

CITY OF ELKHART
WATER SYSTEM MASTER PLAN

VISIONING WORKSHOP SUMMARY

AUGUST 19, 1999

Introduction

As a first step in its update of the Water System Master Plan, the Elkhart Utilities held a Visioning Workshop in order to develop a Vision and Mission Statement that would serve as a guide for the development of a new 20-year Master Plan and planning tools.

Utility participants in the Workshop included:
- Bill Blowers, Chief of Water Operations
- Gary Gilot, Director of Public Works
- Tim Goldy, Pretreatment Coordinator
- Eric Horvath, City Engineer
- Mike Machlan, Network Engineer
- Lynn Newvine, Laboratory Director
- Art Umble, Manager of Water and Wastewater Operations

The following Malcolm Pirnie staff also participated in the Workshop:
- Rick Erhardt, Project Officer
- Melissa Moran, Project Manager
- Sandra Ralston, Workshop Facilitator

The Agenda for the Workshop included the following elements for group discussion:
1. Issues: Who are we, what do we do?
2. Creating a Vision and a Mission Statement
3. Barriers and Challenges to Implementing the Vision
4. Next Steps/Implementation: The role of the Master Plan

The Vision and Mission Statement

The Workshop began with consideration of the nature of the water utility business and the changes that could occur during the next 10 years. Anticipated changes to the Water Utility Business are listed on Attachment 1.

The Workshop participants then divided into two teams to develop, respectively, Vision and Mission Statements, each of which was further refined through discussion by the group as a whole.

The Vision of the Elkhart Water Utility was determined to be:

We will be recognized as a best-in-class water utility.

Elkhart's vision meets the three important criteria for organizational vision statements: it is timeless, inspirational, and serves a decision-making guide.

The Elkhart Water Utility Mission Statement is:

1. *To serve as a reliable provider of quality water*
2. *To maintain customer focus*
3. *To foster professional excellence*
4. *To serve as a steward of our water resource for future generations*
5. *To provide these services at a reasonable cost*

Elkhart's Mission Statement operationally defines the Vision and gives it specificity.

The Workshop participants proceeded to develop implementation strategies for each of the five mission statement elements. The implementation strategies are listed in Attachment 2.

Workshop participants also considered challenges that could impede implementation. Those challenge issues are listed on Attachment 3.

Next Steps

Workshop participants agreed that the Vision and the Mission Statements are acceptable products of the Workshop, and should be formalized through communication to internal and external stakeholders.

An additional step is to develop the scope for Phase I of the Master Plan, making sure that it incorporates or facilitates those action elements identified in the implementation strategy.

Consideration was also given to a second Workshop that would use the Vision and Mission Statements as decision criteria to evaluate key issues and trends.

Finally, a "parking lot" list of issues resulted that could not be considered during the Workshop, but which in some way are important to the implementation of the Vision and Mission Statements. Participants agreed to deliberate these issues in the future:

Privatization impacts, as demonstrated in Indianapolis
Service area details
Employee evaluation system
Political hiring practices
Separation of the civil and utility organizations for rate-making purposes

Attachment 1
Anticipated Changes to the Water Utility Business

How will business change in 10 years?

- More regulations, tighter regulations
- Groundwater under the direct influence impacts
- More staff time and technical expertise required to deal with regulations
- Water system will be 10 years older, will require more attention and replacement resources
- New technologies will benefit efficiency
- More strategic alliances for cost-effective services
- Regionalized utilities; aggregation of small utilities
- Address privatization – private companies have advantages of scale and capitalization; public utilities need to change to compete
- Growth; Elkhart will be larger, service area will change
- Economic downturn is probable in the next decade; a possible result will be public demand for greater utility accountability.

Attachment 2 (Continued)

- Proactive maintenance and prevention
- Use technologies to be more cost-effective
    - have outside auditor on a continual basis to audit capital expenditures and performance accounting
    - review need for investment specialist
    - risk assessment and risk management
    - cost-benefit analysis
    - inventory control
    - planning
    - energy and use audits
    - customer audit for billing
    - expand customer base

Attachment 3
Challenges

- Funding: rates, grants, economy, IURC
- Staff resources, to learn
- Physical space
- Customer complacency about quality
- Collective bargaining and labor issues
- Political framework
- Regulations
- Lack of time
- Interagency jurisdiction (county, state, feds)
- Land use planning (wellhead protection)
- Media
- Locating and acquiring new sources
- Lack of incentives for staff

Section 9
Appendix B

CITY OF ELKHART
PUBLIC WORKS AND UTILITIES

WATER SUPPLY EVALUATION

Brainstorming Session:
Projected Water Demands and New Water Supplies

Thursday December 2, 1999
Meeting Minutes

Attendees:

Art Umble
Gary Gilot
Mike Machlan
Eric Horvath
Lynn Newvine
Bill Blowers
Melissa Moran
Rick Erhardt
Tim Holdeman
Paul Amico
Gary Priscott

1. Demand Projections: Alternative Approaches

A preliminary demand projection was presented at the October 5th Key Issues Workshop. The demand projection was based on information presented in the 1996 Comprehensive Land Use Plan, which projected future land uses for a proposed 2015 Urban Services Area. The land used-based demand projection (Figure 1) was calculated by:

- Determining the acreage outside existing service area but inside the 2015 Urban Services Area. A GIS analysis calculated acreage for five categories: residential, commercial, industrial, multi-family, and municipal.
- Applying 1998 water usage rates for each account class (residential, commercial, industrial, multi-family, and municipal) on a gpd/acre basis.
- Assuming 10% unaccounted for water.
- Using a maximum-day peaking factor of 1.9 (near-term historic 10 year average)

However, several of the participants in the Key Issues Workshop felt that the land use-based projection was very optimistic. By 2015, the projected average-day demand was 19 mgd (nearly double the 1998 average day demand), and a maximum-day demand of about 36 mgd.

For the brainstorming discussion, Malcolm Pirnie predicted future water demands using four alternative curve fits for historic water pumpage: linear, logarithmic, power, and exponential. Linear patterns are typical of consistent increase or decline in water usage.

Logarithmic patterns will represent growth that has leveled off. Power and exponential fits are more appropriate for periods of rapid growth or steadily increasing demand. Each type of regression was applied to both the near-term historic data (1988-1998) and to the longer-term historic data (1964-1998).

The regressions are shown on Figure 1 and 2, attached. The equation of each line and the goodness-of-fit, or R^2, values are shown. For the near-term historic average-day pumpage data, the linear and logarithmic fits resulted in the best R-squared values. For the longer-term historic average-day pumpage data, the linear and logarithmic fits also resulted in the best R-squared values.

For each regression type, the resultant projected water use is summarized in Table 1.

TABLE 1

PROJECTED AVERAGE-DAY PUMPAGE (MGD)

Year	**Near-Term Historic Data (1988-1998)**			**Long-Term Historic Data (1964-1998)**		***Range & Average***
	Linear or Logarithmic Regression	*Power or Exponential Regression*	*Land Use Plan-Based Regression*	*Linear or Logarithmic Regression*	*Power or Exponential Regression*	
1998	NA	NA	NA	NA	NA	10.4
2005	12	12.5	14	10	10.5	10 – 14 11.8
2010	13	14.5	17	10.5	11	10.5 – 17 13.2
2015	14.5	16.5	19.5	11	12	11 – 19.5 14.7
2020	16	18.5	22	11.5	12.5	11.5 – 22 16.1

During the discussions of the alternative water use projections, some expressed that the linear extrapolation of the long-term historical data should give a more realistic projection, one that accounts for the economic downturns which have greatly affected Elkhart's economy in the past. Others countered that the strong growth pattern observed in the past 10 years appears to be continuing and that the projections should be based on regression of the near-term historic data and that a. Most were in agreement that the land use-based projections were very optimistic and that they represented a maximum or ceiling for the long-term water use projections. All agreed that the projection of water usage was increasingly difficult to pinpoint the longer the planning horizon.

Figure 1
Elkhart Water Service Area
Projected Average Day Pumpage
Near-Term Historic Data (1988 - 1998)

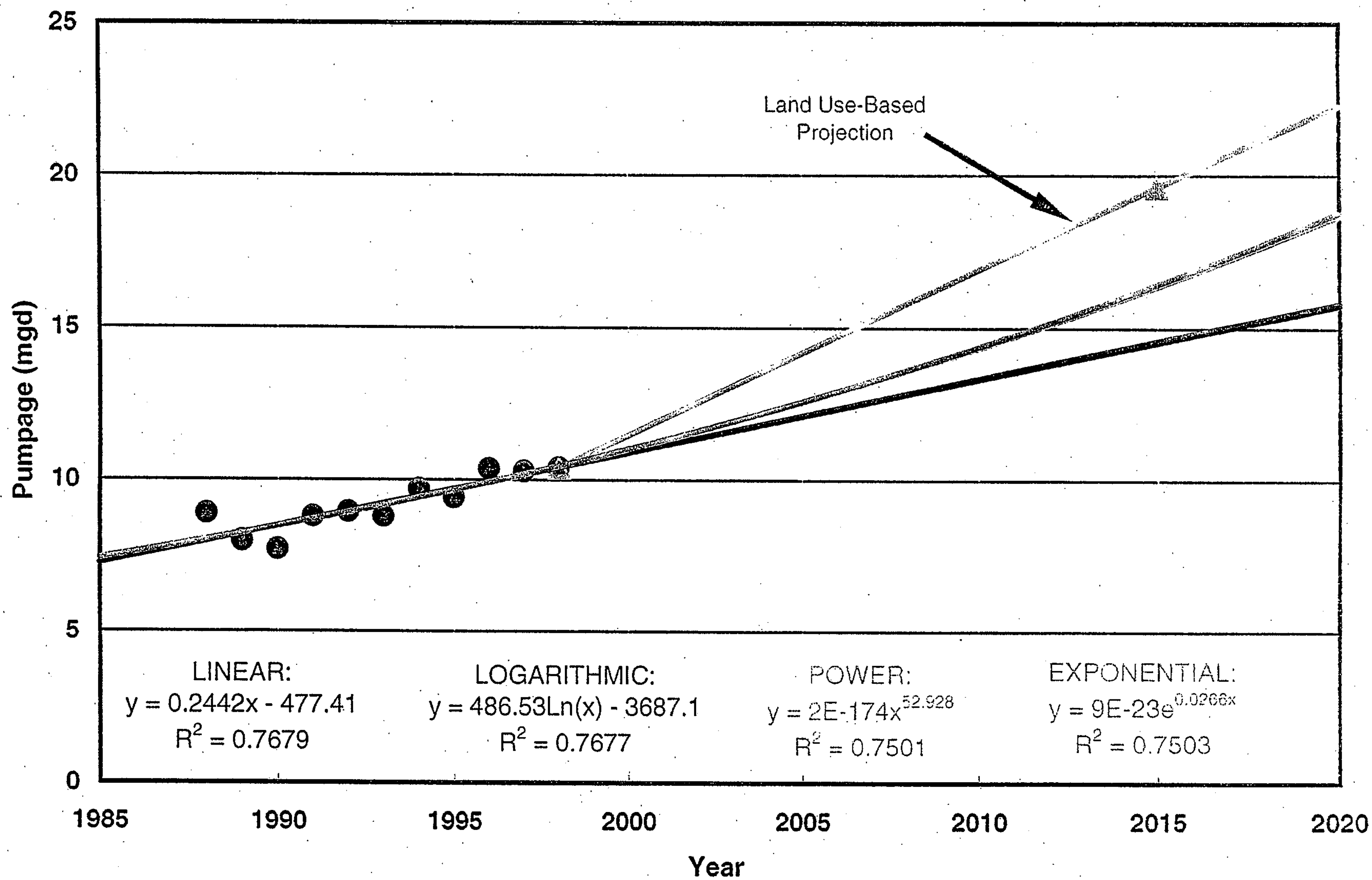


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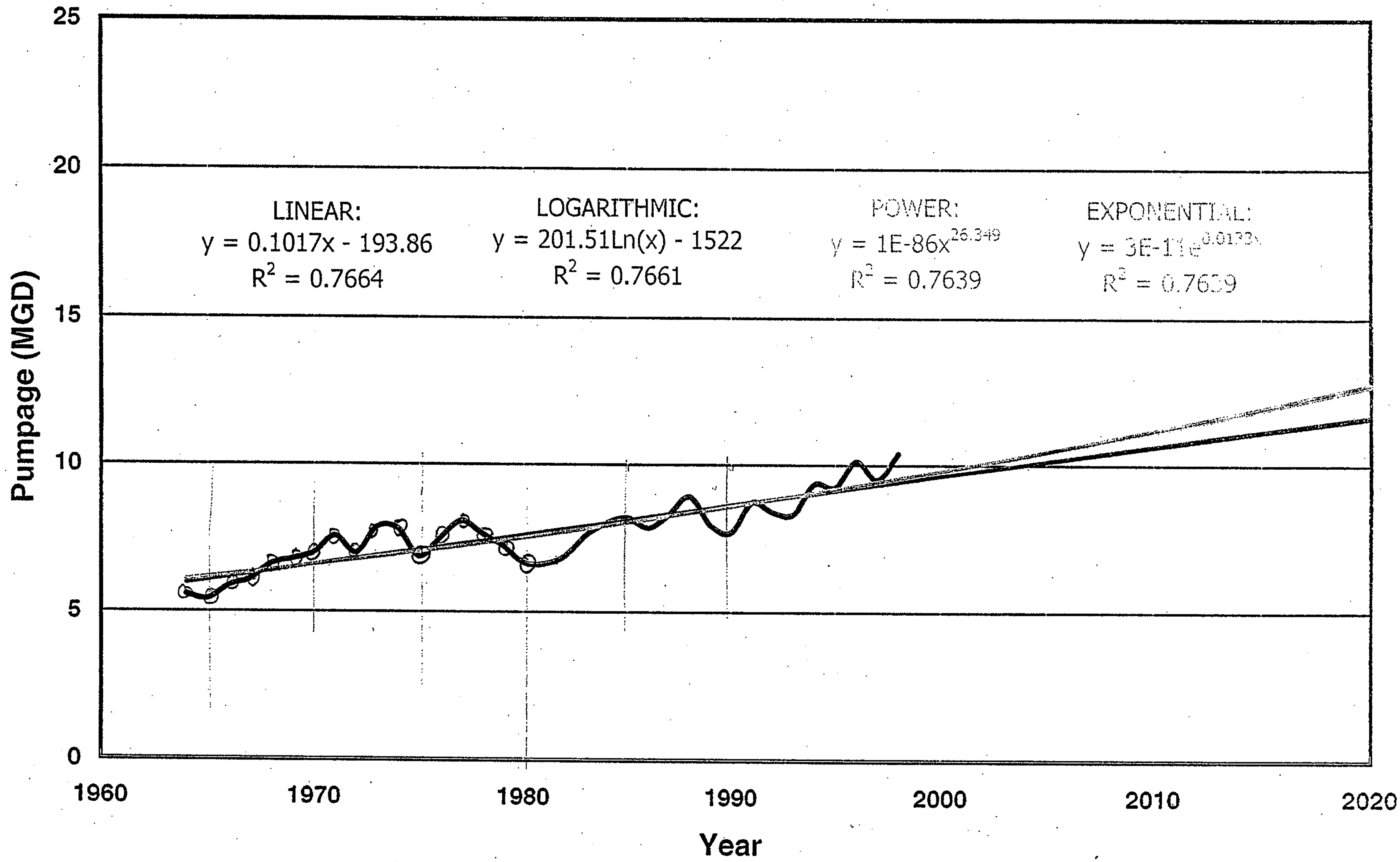
Figure 2
Elkhart Water Service Area
Projected Average Day Pumpage
Long-Term Historic Data (1964 - 1998)



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Generally, the group felt that thinking of the various projections as a range of "potential outcomes" for future water demands would give us a good window within which the master planning could proceed. The ranges for each method of projection are summarized in Table 1, and include an average for the five methods of projecting the future water use.

2. Recommended Capacity for Expansion of Water Supply

In discussing the planning horizon for developing a new water supply, the group agreed that planning for 2015 would be an appropriate time period. Based on a projected average-day demand of approximately 14.7 mgd for 2015 and an average-day usage of about 10.4 mgd in 1998, an additional supply of approximately 4.3 mgd will be needed on an average-day basis. Assuming a peaking factor of 1.9, the maximum-day demand would be projected at about 8 mgd.

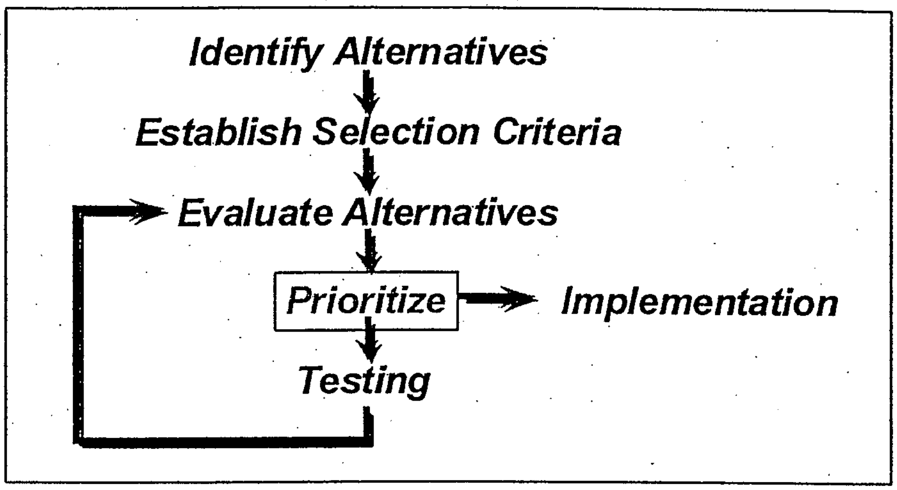
This new capacity assumes that all existing water supplies (estimated system capacity of 22.7 mgd) remain viable over the planning period. However, if some of the supplies must be replaced or redeveloped (for instance, if the shallow North Main Street Wells are determined to be under the direct influence of surface water), then additional capacity beyond 8 mgd may need to be considered.

Generally, everyone agreed on the 8 mgd capacity as a good starting point for planning the new or expanded water supply. Several in the group recommended planning the development of the supply so that it could be added incrementally. For instance, initially, the supply could be developed at 6 mgd. If the anticipated demands were realized, then the additional 2 mgd would be added as needed. However, if the anticipated demands were not realized, then the plant expansion could be delayed until a later time.

3. Alternative Sources of Supply for the Future
and
Criteria for Evaluating Alternative Supplies

In the second part of the brainstorming session we started the process of developing multiple working alternatives for meeting future supply demands. This process is outlined in the following diagram.

Multiple Working Alternatives Promotes Best in Class Decisions



Brainstorming the alternative sources of supply for the future constitutes the first step in developing multiple working alternatives. For this step, participants were encouraged to consider all alternatives as if creating a "wish list", and to avoid prejudging or prematurely disqualifying an idea. During brainstorming all alternatives for new supply sources were recorded on poster size paper and hung on the wall for viewing. The alternatives were discussed and refined prior to finalizing the list, although none of the alternatives presented in the brainstorming session were discarded. Twelve alternatives are represented in the final list and are included as the first column in the matrix presented as Table 2.

The criteria for evaluating alternative supplies were established as the second step in developing the multiple working alternatives. Similar to brainstorming for the alternatives, ideas for the selection criteria were recorded on poster size paper and hung on the wall. The selection criteria were reviewed and discussed by the group. During the review, criteria with very similar meaning were combined and assigned a new descriptive name. Ten selection criteria were selected and are included as the column headings in the matrix presented as Table 2.

The matrix constructed from the alternatives and selection criteria will be used to begin evaluating the alternatives.

MALCOLM PIRNIE

WATER SYSTEM MASTER PLAN
TECHNICAL MEMORANDUM

DISTRIBUTION SYSTEM HYDRAULIC MODEL: ALLOCATION OF WATER SYSTEM DEMANDS

CITY OF ELKHART
PUBLIC WORKS AND UTILITIES

OCTOBER 2000

Malcolm Pirnie, Inc.
8440 Woodfield Crossing Blvd. #175
Indianapolis, IN 46240

1.0 EXECUTIVE SUMMARY

Allocation of the water demand to appropriate locations within the distribution system pipe network is one of the first steps toward calibration of a system hydraulic model. A unique approach to demand allocation was taken for the City of Elkhart's model. Actual metered water data from the Utility Data Corporation was used to develop the average day water demand for Elkhart. Using actual billing data is more accurate than the traditional water use allocation; for a given period of time (i.e., a meter reading cycle), the water usage for every metered user in the City is known. Geocoding is the process used to allocate the demands for each metered customer to the distribution system network to its appropriate geographic location. The demand allocation process was very successful for our project, with over 70 percent of the records matching locations on the first attempt. This efficient process for demand allocation will simplify the remaining model calibration effort.

Now that demands have been appropriately allocated, the project team is completing the calibration of the hydraulic model. The calibrated present-day model will be built upon to conduct "what if" evaluations for future conditions. For example, growth in the northeast will create additional water demand. To continue providing reliable service to its water customer, Elkhart must be able to answer the following types of questions:

- How does the additional demand affect Elkhart's existing water system?
- What system deficiencies are identified in the system when the additional demand is applied?
- What types of improvements must be made to the system to correct those deficiencies?
- What capital programs are required to complete they system improvements?

The calibrated hydraulic model will be used to evaluate system deficiencies under future conditions. The model will also be used to evaluate alternative improvements to system deficiencies. Ultimately, the identified improvements will be the basis for Elkhart's capital improvement program.

This document summarizes the process used to allocate demand to the pipe network in the hydraulic model of Elkhart's water distribution system.

2.0 DATA INPUT

The following table describes the data input for this process:

Data Set	Source	Use
Metered consumption	Utility Data Corporation (UDC)	Customers' addresses for geocoding; demand for each customer
Elkhart Address Coverage (GIS)	City of Elkhart	Base map of streets to which customers could be geocoded
Node polygons	Malcolm Pirnie (created for this project)	Associate customer points and associated demands with model nodes

3.0 THE PROCESS

Figure 1 illustrates the detailed steps used to allocate metered consumption to the model nodes. A brief description of the process follows.

Step 1: Geocoding. The result of geocoding is the placement of a point in the GIS that represents the record (i.e., customer) that matched. Geocoding in effect, assigned each customer a location within Elkhart's street right-of-way grid. The process of geocoding resulted in the original set of data being "split" into two categories, those records that matched, and those that didn't. The matched data set contains 13,654 records, while the unmatched data set contained 3,922 records.

Step 2: Calculation of Average Demand for Each Record. Given that:

1. Customers' water meters are read once each month, so only the average day during a monthly reading period can be calculated;
2. The peak day in 1999 occurred on June 9; and
3. The data for the reading period containing the peak day was spread over six "sets" of fields in the database,

some spreadsheet and database analyses were necessary to determine the average demand for each customer. As a result of these analyses, some of the dates for the accounts were found to be invalid, and some water usage readings either contained no data or a zero in the field. These incomplete data, which were included in both the matched and the unmatched categories, were deemed "invalid".

Step 3: Spatial Join. Malcolm Pirnie created a map layer of "polygons" that would allow a group of customers' water usage information to be combined and applied to a specific point, or node, in the distribution system. The polygons "acquired" the water demands from a group of customers by performing a spatial join using GIS.

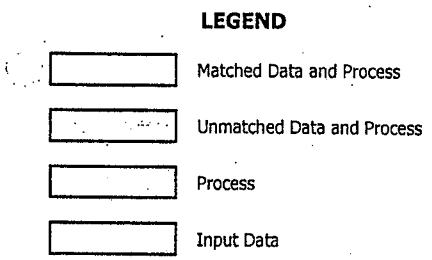
4.0 SUMMARY

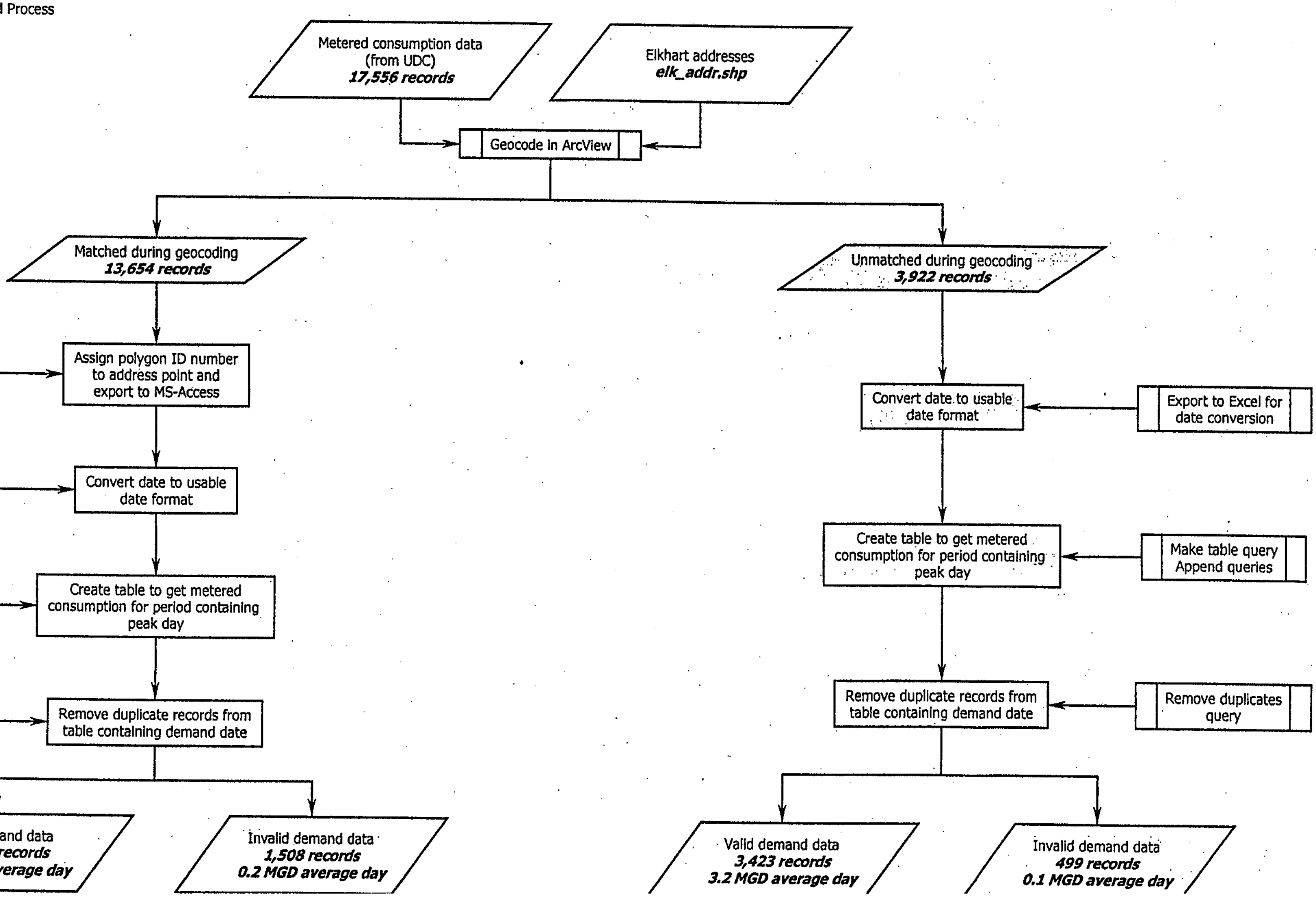
The following table summarizes the number of records and average demand calculated for each of the four categories of data developed during this "demand allocation" process.

	Matched	Unmatched
Valid	12,126 records 7.5 MGD	3,423 records 3.2 MGD
Invalid[1]	1,508 records 0.2 MGD	499 records 0.1 MGD
Record Subotal	13,654 records	3,922 records

[1] Calculated using Average Demand field

City of Elkhart
Water System Master Plan
Model Node Demand Allocation





MALCOLM PIRNIE

WATER SYSTEM MASTER PLAN
TECHNICAL MEMORANDUM

WATER SUPPLY EVALUATION: EVALUATION OF ALTERNATIVES

CITY OF ELKHART
PUBLIC WORKS AND UTILITIES

OCTOBER 2000

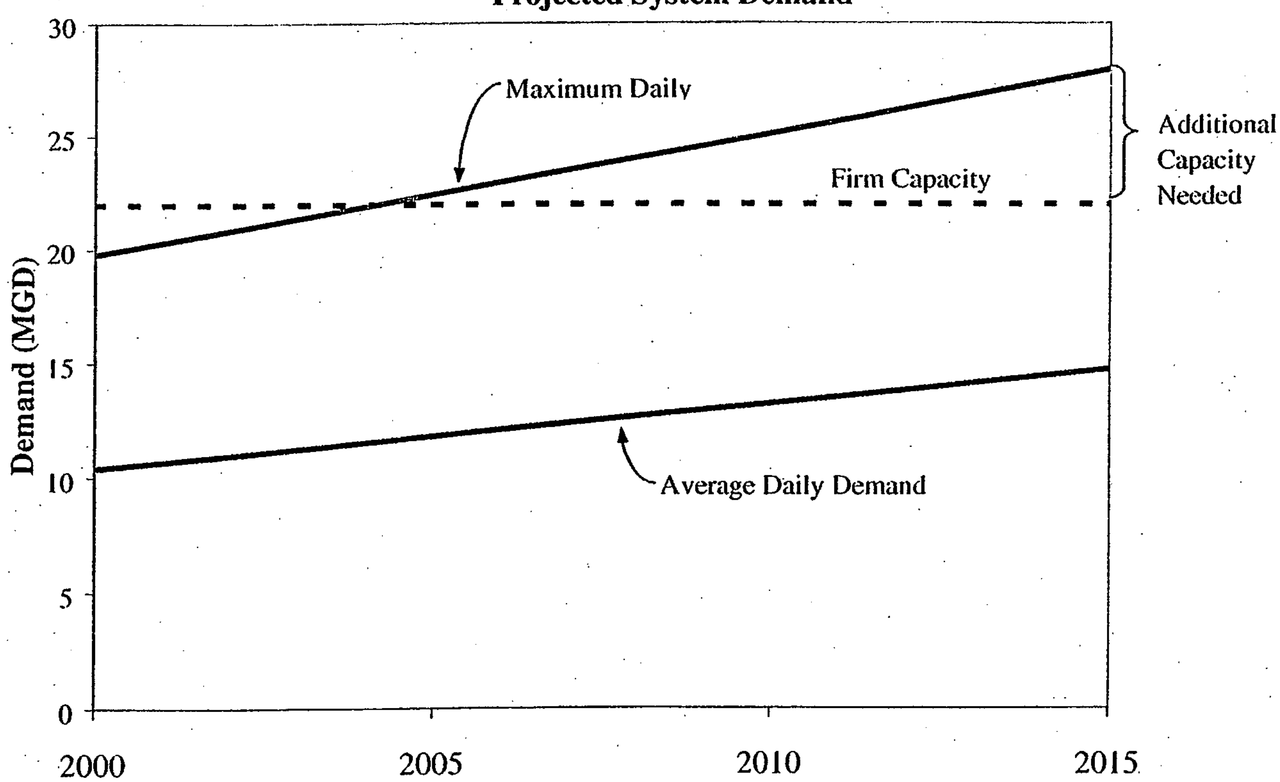
Malcolm Pirnie, Inc.
8440 Woodfield Crossing Blvd. #175
Indianapolis, IN 46240

1.0 INTRODUCTION

The Elkhart Public Works and Utilities recently adopted a planning horizon of 15 years (year 2015) for their Water System Master Plan. Through a series of workshops and evaluations, it was concluded that approximately 8 million gallons per day (mgd) of additional capacity is needed to meet maximum daily demands in 2015.

As shown in Figure 1, the average daily demand is projected to increase from about 10.4 mgd in 1998 to 14.7 mgd in 2015. Applying a peaking factor (ratio of maximum daily demand to average daily demand) of 1.9, the maximum daily demand during the same period will increase from about 19.8 mgd to 27.9 mgd. The firm capacity (capacity with the largest well in each well field out-of-service) of the current system is approximately 22 mgd. The need for 8 million mgd of additional capacity by 2015 is based on the difference between the maximum daily demand and firm capacity in 2015 plus a contingency to account for the uncertainty in projecting the future. The projected need for additional capacity assumes that all existing water supplies remain viable, in terms of aquifer capacity and well yield, over the planning period. If some of the existing supplies require replacement or redevelopment, then additional capacity beyond 8 mgd may need to be considered.

Figure 1 -
Projected System Demand



In December 1999, an evaluation of alternatives for obtaining the 8 mgd of additional capacity was completed by a work group comprised of seven representatives of Elkhart Public Works and Utilities and five representatives of Malcolm Pirnie. The group identified fourteen alternatives and 10 selection criteria. Each participant individually evaluated all fourteen alternatives against the selection criteria using a simple ranking scheme of high, medium, and low. The evaluations were compiled and the alternatives were ranked relative to one another. The alternatives receiving the highest scores were:

1) Add capacity to the Northwest Well Field,
2) Water conservation,
3) Redrill and rehabilitate North Main Street Well Field, and;
4) Add capacity to the South Well Field.

This document presents the results of technical evaluations conducted to determine the feasibility of obtaining the needed 8 mgd of additional capacity from alternatives 1, 3, and 4.

2.0 FINDINGS

2.1 Add Capacity to the Northwest Well Field

The Northwest Well Field consists of five production wells (PW-1 through 5) and a ground water supply protection system comprised of two recharge wells (RW-1 and 2) and three barrier wells (BW-1 through 3). All of the wells were installed in 1990 and are completed in the upper sand and gravel aquifer. A summary of key characteristics of the wells is presented in Table 1.

TABLE 1

SUMMARY CHARACTERISTICS OF WELLS IN THE NORTHWEST WELL FIELD

Well	Well Depth (feet bgs*)	Screen Length (feet)	Rated Capacity (gpm)	Original Static Level (feet bgs)	Original Pumping Level (ft bgs)	Original Specific Capacity (gpm/ft)
PW-1	76	30	750	19.4	24.3 @ 1305 gpm	266.3
PW-2	76	30	750	16.7	25.9 @ 1310 gpm	142.4
PW-3	71	30	750	17.6	26.6 @ 1310 gpm	145.6
PW-4	71	30	750	17.9	30.9 @ 1312 gpm	100.9
PW-5	74	30	750	16.6	27.4 @ 1312 gpm	121.5
RW-1	84.5	30	145	18.8	32 @ 1305 gpm	98.9
RW-2	81.5	30	145	20.3	29 @ 1305 gpm	150
BW-1	94	40	NA	16	NA	NA
BW-2	100	40	NA	16	NA	NA
BW-3	80	40	NA	18	NA	NA

Notes: All wells were installed in 1990, are 24 inches in diameter, and are completed in the Upper Sand and Gravel Aquifer.
* bgs; below ground surface

The ground water supply protection system uses the recharge wells to extract ground water from the aquifer and the barrier wells to inject that water back into the aquifer. The system creates a ground water ridge between the production wells and areas of known contamination. The ground water ridge serves as a hydraulic barrier, preventing the migration of contaminants into the production wells. The recharge wells extract ground water at the rate of approximately 145 gallons per minute (gpm). A network of observation wells (OW-1 through 5) and monitoring wells (MW-1 through 7) are used to monitor ground water quality and level. This network provides data for evaluating the effectiveness of the ground water supply protection system and for identifying ground water contamination that may be approaching the well field area.

An evaluation was conducted to assess the feasibility of adding ground water supply capacity by constructing additional production wells in the Northwest Well Field. The evaluation included a review of operational records (well performance, static and pumping ground water levels, and hours of operation) and information on the hydraulic characteristics of the aquifer (pumping test data gathered as part of the well field design). This information was used to develop and calibrate an analytical ground water flow model. The model was used to simulate the effect (i.e., how much ground water levels would be lowered) of constructing and operating up to four additional production wells on property currently owned by the City and expanding the ground water supply protection system accordingly.

Results of the evaluation indicate that adding four production wells at 750 gpm each in the area immediately west of the existing well field would lower the ground water level in the existing wells by approximately five to seven feet, which is acceptable under current operating conditions. The key assumptions applied in the evaluation are:

1) spacing and configuration of additional production, recharge, and barrier wells are similar to that of the existing wells,
2) aquifer characteristics of the area (approximately 15 acres) to the west of the existing well field are similar to that of the existing well field,
3) the design, capacity, and operation of production and recharge wells are similar to that of the existing wells, and;
4) summer 1999 static ground water levels are indicative of ground water levels during drought conditions.

Operational records of the existing production wells indicate that lowering ground water levels by five to seven feet will not have an adverse effect on the existing wells. Thus, it appears that the capacity of the Northwest Well Field could be expanded to 9.7 mgd total capacity with a firm capacity (capacity with the largest well out-of-service) of 8.6 mgd, representing an increase in capacity of 4.3 mgd (Table 2). This conclusion assumes that the wells are kept in good operating condition. That is, well performance records are kept and evaluated on an ongoing basis to identify the need for well rehabilitation and that when the need for well rehabilitation is identified it is performed in a timely manner and it is effective.

In the event the Elkhart Public Works and Utilities elects to pursue this alternative, aquifer characterization testing should be conducted to confirm the validity of the assumptions employed in this feasibility analysis. In addition, a system for evaluating well performance that identifies the need for well rehabilitation and its effectiveness should be developed and implemented. Lastly, it must be understood that significant costs will be incurred through the expansion of the water treatment plant to accommodate the additional wells. Such an expansion was considered in the original design of the water treatment plant.

without lowering the pumping water level below the pump setting. The decline in static water levels is probably a result of several factors including:

1) constant pumping of interceptor wells,
2) inability of streams and rainfall to provide sufficient recharge to replace the water withdrawn from the aquifer, and;
3) lower aquifer transmissivity caused by reductions in the saturated thickness of the aquifer.

In addition, wells A through E are routinely operated with pumping water levels below the top of the well screens. Operating wells in this manner promotes encrustation of the well screens; thus, the wells require more frequent cleaning.

TABLE 3

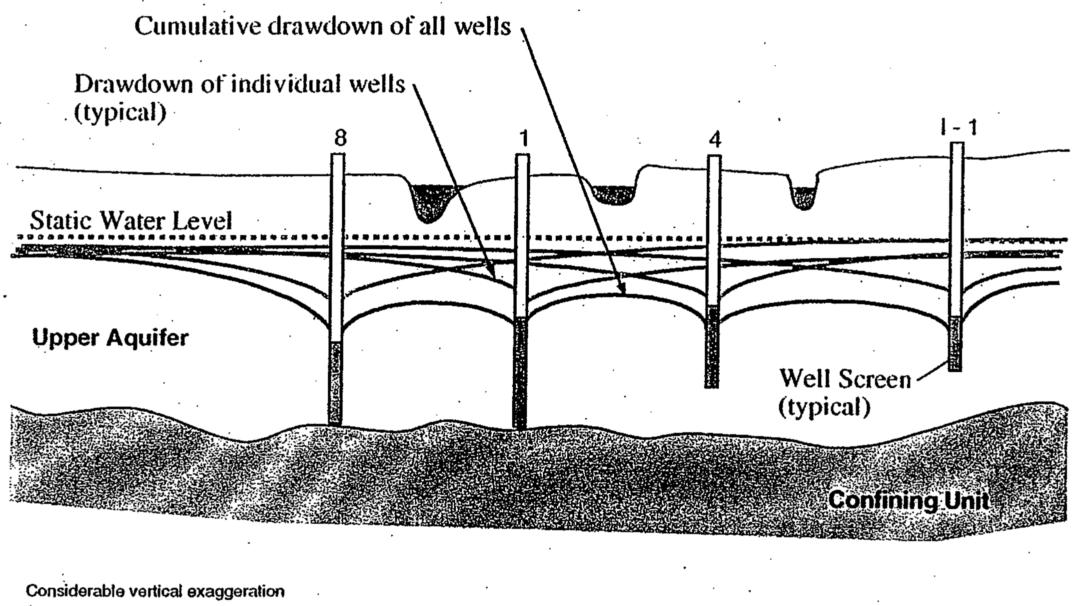
SUMMARY CHARACTERISTICS OF WELLS IN THE NORTH MAIN STREET WELL FIELD

Well	Year Installed	Well Depth (ft bgs)	Screen Length (feet)	Rated Cap. (gpm)	Orig. Static Level (ft bgs)	Original Specific Capacity (gpm/ft)	Recent* Static Level (ft bgs)	Recent* Specific Capacity (gpm/ft)
1	1961	60	20	792	13	114.9	28	93.2
2B	1976	50	15	800	12	100	16	100
3 (2)	1926	49.5	15?	800	6	69.4	11	145.4
4	1945	46	15	703	8	100	20	70.3
5	1973	61	15	800	19	120	22	124.1
6	1974	60	15	800	16	125	28	266.6
7	1974	58	15	800	8	46.2	10	61
8	1974	54	15	800	9	60	22	86.5
9	1977	62	15	800	19	83.3	27	102
10	1977	62	15	800	19	62.5	25	62.4
A	1949	46	20	800	10	126.9	24	113.7
B	1949	46.5	20	800	6.9	79.6	20	78.8
C	1949	46	20	800	11.6	79.9	35	67.8
D	1949	45	20	800	10	101.5	25	100.5
E	1944	43.5	20	800	9.6	222.2	32	80.2
I-1	1982	46	10	1000	10	119	20	90.9
I-2	1982	44.5	10	396	10	92.9	20	44
I-3	1994	64	15	350	17	92.9	26	100
I-4	1994	51	15	350	17	83	20	83.3

*Recent static water levels and specific capacity values obtained from operating records and well maintenance records from 1997 to 2000.

Current well maintenance practices (i.e., cleaning wells screens to enhance their hydraulic efficiency) appear to be effective in restoring the specific capacity of nearly all the wells in the North Main Street Well Field. Thus, reduced well efficiency experienced over time is (for the most part) recovered through routine well cleaning and is not the controlling factor for well replacement. Rather, it is well interference (the lowering of water levels in a well caused by the operation of other wells) and the small amount of available drawdown (depth to the top of well screen minus depth to static water level) that are the controlling factors as illustrated in Figure 2.

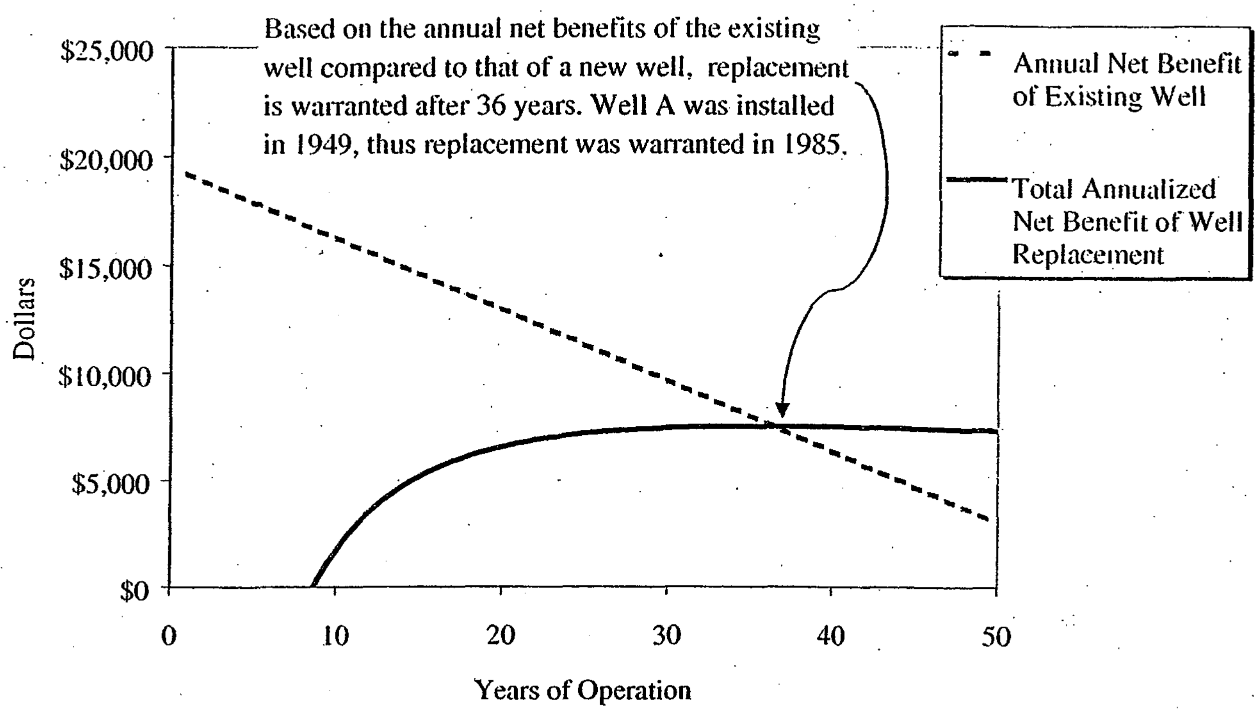
Figure 2 - Well Interference Effects at the North Main Street Well Field



An economic analysis of well replacement was conducted for well A. This well is considered representative of the oldest wells in the well field, A, B, C, D, and E. The economic analysis is based on comparing the annual net benefit (economic value of the water minus the cost of producing that water) of the existing well to the annualized (amortized) net benefit of a new well. The analysis shows when a well should be replaced due to the natural decline in well performance. Well replacement is warranted when the net benefit of replacement is greater than the net benefit of the existing well.

The results of the economic analysis for well A are shown in Figure 3. On the basis of the analysis, the net benefit of replacement becomes greater than the net benefit of the existing well beyond 36 years, or 1985. The key assumptions in this analysis are 1) the replacement well could be operated at 800 gpm (compared to 400 gpm for the existing well from current operational records) and 2) the replacement well could be operated for an average of 12 hours per day (compared to 4 hours per day for the existing well from current operational records). These assumptions are considered reasonable on the basis of advances made in well construction (materials and installation techniques) over the past 50 years.

Figure 3 - Economic Analysis of North Main Street Well A



On the basis of existing information, additional capacity at the North Main Street Well Field may be possible by installing wells in the deeper aquifer. Production wells completed in the deeper aquifer would have to be designed and constructed in a manner that would not provide a pathway for contaminants in the upper aquifer to migrate to the lower aquifer. Although somewhat speculative, production wells completed in the deeper aquifer could yield 800 gpm each. Testing will be required to confirm the availability of adding capacity by installing deep production wells.

It appears that the capacity of the North Main Street Well Field could be expanded to 19 mgd total capacity with a firm capacity of 17.6, for an increase of 1.7 mgd (Table 4). This would entail replacing wells A, B, C, D, and E with two new wells (near the location of wells A and C) in the shallow aquifer, and installing two new wells in the deep aquifer. Because wells A through E are only operated in the summer, replacing them with wells that can be used all year will reduce the hours of operation of the other wells in the well field, prolonging the life of those wells. Also, replacing only two of wells increases the average distance between the wells, thereby reducing the effects of well interference. Lastly, it should be recognized that expansion of the North Main Street Well Field might require an upgrade of the treatment process.

TABLE 4

POTENTIAL INCREASED CAPACITY AT NORTH MAIN STREET WELL FIELD

	Current Capacity (gpm)	Feasible Capacity (gpm)	Increase in Capacity (gpm)
1	792	792	0
2B	800	800	0
3 (2)	800	800	0
4	703	703	0
5	800	800	0
6	800	800	0
7	800	800	0
8	800	800	0
9	800	800	0
10	800	800	0
A	400*	*800*	400
B	400*	0	(400)
C	400*	*800*	400
D	400*	0	(400)
E	400*	0	(400)
Deep-1	*0*	*800*	800
Deep-2	*0*	*800*	800
I-1	1000	1000	0
I-2	396	396	0
I-3	350	350	0
I-4	350	350	0
Total* (gpm)	11991	13191	1200
Total* (mgd)	17.27	19.00	1.73
Firm (gpm)	10991	12191	1200
Firm (mgd)	**15.83**	**17.56**	**1.73**

* although wells A through E have pumps capable of 800 gpm they are operated at 400 gpm to avoid drawing water levels below the pump settings

2.3 Add Capacity to the South Well Field

The South Well Field consists of 3 production wells completed in the lower sand and gravel aquifer. A summary of key characteristics of the wells is presented in Table 5.

TABLE 5

SUMMARY CHARACTERISTICS OF WELLS IN THE SOUTH WELL FIELD

Well	Well Depth (feet bgs)	Screen Length (feet)	Rated Capacity (gpm)	Original Static Level (feet bgs)	Original Pumping Level (ft bgs)	Original Specific Capacity (gpm/ft)	Recent* Specific Capacity (gpm/ft)
1	104	30	570	19	60 @ 1421 gpm	34.7	14.8
2	100	30	800	12.5	34 @1100 gpm	51.2	39.9
3	102	25	686	20	34 @1240 gpm	88.6	62.6

Notes: Well 1 was installed in 1964 and is 18 inches in diameter, well 2 was installed in 1966 and is 18 inched in diameter, and well 3 was installed in 1973 and is 16 inches in diameter. All the wells are completed in the Lower Sand and Gravel Aquifer.
* Recent specific capacity values obtained from flow tests conducted in 2000.

An evaluation was conducted to assess the feasibility of adding ground water supply capacity by constructing additional production wells in the South Well Field. The evaluation was similar to the one conducted for the Northwest Well Field, which is described in Section 2.1. The ground water flow model used to simulate the effect (i.e., how much ground water levels would be lowered) of constructing and operating up to two additional production wells.

Results of the evaluation indicate that adding one production well at 800 gpm approximately 475 feet east of the existing wells (on property owned by the City of Elkhart) would lower ground water levels in the existing wells by up to approximately ten feet due to well interference. Adding a second production well in the same area at 800 gpm would lower the ground water levels in the existing wells by up to an additional ten feet. The key assumptions applied in the evaluation are:

1) aquifer characteristics of the area to the east of the existing well field are similar to that of the existing well field
2) the design, capacity, and operation of production and recovery wells is similar to that of the existing wells
3) summer 1999 static ground water levels are indicative of ground water levels during drought conditions

Operational records of the existing production wells indicate that lowering ground water levels by 10 feet will not have an adverse effect on wells 2 and 3. However, the additional drawdown would lower pumping water levels below the top of the well screen in well 1. Adding two production wells would lower pumping water levels below the top of the well screen in both wells 1 and 2. The decline in specific capacity experienced for well 1 has been extraordinary and is attributable largely to the lack of proper maintenance. It appears that well 1 could be replaced by a well that would perform similar to wells 2 and 3. If that could be accomplished, one additional 800 gpm well could be added to the South Well Field.

The conclusions drawn from this analysis assumes that the wells are kept in good operating condition. In the event the Elkhart Public Works and Utilities elects to pursue this alternative, testing should be conducted to confirm the validity of the assumptions employed in this feasibility analysis. In addition, a system for evaluating well performance that identifies the need for well rehabilitation and its effectiveness should be developed and implemented.

An economic analysis of well replacement was conducted for well 1. The analysis was similar to the one conducted for the North Main Street Well Field, which is described in Section 2.2. On the basis of the economic analysis, replacement of well 1 is warranted after 39 years, or 2003. The key assumptions in this analysis are 1) the replacement well could be operated at 800 gpm (compared to 560 gpm for the existing well) and 2) the replacement well could be operated for an average of 16 hours per day (compared to 12 hours per day for the existing well). These assumptions are considered reasonable on the basis of the well performance history of wells 2 and 3.

On the basis of these evaluations, it appears that the capacity of the South Well Field could be expanded to 4.5 mgd total capacity with a firm capacity of 3.3, for an increase of 1.5 mgd above existing conditions (Table 6).

TABLE 6

POTENTIAL INCREASED CAPACITY AT SOUTH WELL FIELD

	Current Capacity (gpm)	Feasible Capacity (gpm)	Increase in Capacity (gpm)
1	570	*800*	230
2	800	800	0
3	696	696	0
4		*800*	800
Total (gpm)	2066	3096	1030
Total (mgd)	2.98	4.46	1.48
Firm (gpm)	1266	2296	1030
Firm (mgd)	**1.82**	**3.31**	**1.48**

3.0 CONCLUSION

Each of the three alternatives for adding water supply capacity to the City of Elkhart's public water supply system is considered viable. The estimated additional capacity that is likely to be realized from pursuing these alternatives is presented in Table 7.

TABLE 7

SUMMARY OF POTENTIAL TOTAL INCREASED WATER SUPPLY CAPACITY

	Current Capacity	Feasible Capacity	Increase in Capacity
NORTHWEST WELL FIELD			
Total (gpm)	3750	6750	3000
Total (mgd)	5.40	9.72	4.32
Firm (gpm)	3000	6000	3000
Firm (mgd)	**4.32**	**8.64**	**4.32**
NORTH MAIN STREET WELL FIELD			
Total (gpm)	11991	13191	1200
Total (mgd)	17.27	19.00	1.73
Firm (gpm)	10991	12191	1200
Firm (mgd)	**15.83**	**17.56**	**1.73**
SOUTH WELL FIELD			
Total (gpm)	2066	3096	1030
Total (mgd)	2.98	4.46	1.48
Firm (gpm)	1266	2296	1030
Firm (mgd)	**1.82**	**3.31**	**1.48**
GRAND TOTAL			
Total (gpm)	17807	23037	5230
Total (mgd)	25.64	33.17	7.53
Firm (gpm)	15257	20487	5230
Firm (mgd)	**21.97**	**29.50**	**7.53**

"Order of Magnitude" costs have been developed for each of the three alternatives described above and are presented in Table 8. The cost of developing a new well field has been included for comparison purposes.

TABLE 8

"ORDER OF MAGNITUDE" COST SUMMARY FOR INCREASING WATER SUPPLY CAPACITY

	Order of Magnitude Cost	Increase in Capacity (mgd)	Cost per Million of Gallons Added
NORTHWEST WELL FIELD			
TOTAL	$15,675,000	4.32	$3,628,472
NORTH MAIN STREET WELL FIELD			
TOTAL	$1,815,000	1.73	$1,050,347
SOUTH WELL FIELD			
TOTAL	$4,068,000	1.48	$2,742,718
GRAND TOTAL	$21,558,000	7.53	$2,862,492
NEW WELL FIELD	$19,800,000	5.00	$3,960,000

North Main Street alternative does not include treatment costs.

ELKHART WATER MASTER PLAN
NEW 8 MGD WATER SUPPLY FOR 2015

RESULTS OF MATRIX ANALYSIS TO DETERMINE THE HIGHEST PRIORITY ALTERNATIVES

Brainstorming Workshop

On December 2, 1999 the master plan project team members (representatives from the City of Elkhart and from Malcolm Pirnie) met to brainstorm ideas to meet current and future water demands in Elkhart.

At the brainstorming workshop, participants were encouraged to consider all alternatives for a new water supply as if creating a "wish list", and to avoid prejudging or prematurely disqualifying an idea. All ideas for new water supplies were recorded and discussed; none of the alternatives presented in the brainstorming session were discarded. Fourteen alternatives were represented in the final list. The criteria for evaluating the alternative supplies were also established during the workshop. Ten criteria were identified as the most important factors for selecting a new water supply.

The fourteen alternatives and ten selection criteria became the row and column headings, respectively, in a matrix, which was used to analyze and prioritize the alternatives for a new water supply in Elkhart.

Matrix Analysis

All seven of the City of Elkhart team members and all five of the Malcolm Pirnie team members that participated in the brainstorming session completed the matrix. Each participant relied on current knowledge and best professional judgment to complete their evaluation.

Each workshop participant completed the matrix by considering each of the selection criteria separately. Then, with reference to each specific selection criterion, each alternative was evaluated relative to the others. The participants ranked each alternative qualitatively using the descriptions high, medium, or low, with high meaning that an alternative was favorable relative to a specific criterion. A favorable alternative would have received many "high" rankings, while an unfavorable alternative would have received many "low" rankings.

Results of Matrix Analysis

The results of all 12 participants' evaluations were compiled into a single matrix and ranked. The alternatives receiving the highest overall score (having the highest number of "H" ratings) are:

1. Add capacity to the Northwest Well Field
2. Water conservation
3. Redrill and rehabilitate North Main Street Well Field
4. Add capacity to the South Well Field

Plan for More Refined Evaluation of Alternatives

At this time, these four alternatives are determined to be the highest priority alternatives for expanding Elkhart's water supply. These four alternatives will be evaluated in more detail to determine whether 8 mgd additional capacity is available from these sources. In addition, preliminary opinions of costs associated with each of the four priority alternatives will be prepared.

The remaining alternatives will not be evaluated at this time. They will remain lower-priority alternatives that could be evaluated in the future should these top four alternatives not be able to meet the new water supply objectives.

City of Elkhart Water Master Plan

New 8 MGD Water Supply for 2015

Composite Analysis of 12 Independent Evaluations

	Quality	Vulnerability	Land Availability, Acquisition and Control	Sustainability and Interference	Yield	Environmental/ Ecological Impacts	Proximity to Existing Infrastructure (Transport)	Treatment Issues	Acceptability	Time Factors	Sum	Total H	Total M	Total L	Rank
1. Add Capacity to Northwest Wellfield	M	M	H	M	M	H	H	H	H	H	25.3	6	4	0	1
10. Water Conservation	H	M	H	M	M	H	H	H	M	M	24.3	5	5	0	2
5. Redrill and Rehabilitate North Main Street (e.g. deep aquifer)	M	M	H	M	M	H	H	M	M	H	24.3	4	6	0	2
2. Add Capacity to South Wellfield	M	M	M	M	M	H	H	M	H	H	23.9	4	6	0	4
14. Additional Storage	H	H	M	M	M	M	M	M	H	M	22.2	3	7	0	5
12. Water Purchase	M	M	M	M	M	H	L	H	M	M	21.6	2	7	1	6
4. Bayer Wells Hooked to North Main Street	M	M	M	M	M	M	M	M	M	M	20.9	0	10	0	7
6. Groundwater Recharge System	M	M	M	M	M	M	M	M	M	M	19.7	0	10	0	8
13. Regionalize with Surrounding Community	M	M	M	M	M	M	M	M	M	L	19.4	0	9	1	9
8. Surface Water Induced Infiltration - St. Joseph	M	M	M	M	H	M	M	M	M	M	19.1	1	9	0	10
3. Construct Northeast Wellfields	M	M	L	M	H	M	M	M	M	L	18.9	1	7	2	11
7. Surface Water - Direct Intake St. Joseph	L	L	M	M	H	M	M	L	M	L	17.6	1	5	4	12
11. Water Reclamation	L	L	M	M	M	H	M	L	L	L	17.3	1	4	5	13
9. Surface Water - Direct Intake Lake Michigan	M	L	L	M	H	M	L	L	L	L	15.4	1	3	6	14

City of Elkhart Participants: Bill Blowers, Gary Gilot, Tim Goldy, Eric Horvath, Lynn Newvine, Mike Machlan, Art Umble
Malcolm Pirnie Participants: Paul Amico, Rick Erhardt, Tim Holdeman, Melissa Moran, Gary Priscott.

MALCOLM PIRNIE

WATER SYSTEM MASTER PLAN TECHNICAL MEMORANDUM

THE NEXT STEP: DEVELOPING A CAPITAL IMPROVEMENTS PLAN

CITY OF ELKHART
PUBLIC WORKS AND UTILITIES

OCTOBER 2000

Malcolm Pirnie, Inc.
8440 Woodfield Crossing Blvd. #175
Indianapolis, IN 46240

1.0 CAPITAL IMPROVEMENT PLAN DEVELOPMENT

The goal of the Water System Master Plan is to develop a Capital Improvement Plan (CIP) for the Elkhart Water System. The appropriate time to make the recommended improvements to the water system will be determined by modeling future system conditions using the WaterCAD model of the distribution system. The actual sequence of the capital improvements will depend upon the results of the hydraulic modeling.

2.0 COST EFFECTS OF CAPITAL IMPROVEMENT TIMING

Figure 1A illustrates one hypothetical approach to the capacity improvements and the corresponding capital expenditure phasing:

Make all well field improvements in 2005. If all improvements are made in 2005, the Elkhart's water system would be able to meet the projected maximum day demands for 2015 in 2005, and no additional improvements would be needed until after 2015. The debt service for the capital investments would (hypothetically) be paid over the 20-year period between 2005 and 2025. The cumulative annualized costs of this early-investment strategy would be approximately $57M.

Figure 1B illustrates a second hypothetical approach to the capacity improvements and the corresponding capital expenditure phasing:

Make all well field improvements in 2015. If all improvements were made in 2015, then Elkhart's water system would not be expected to be able to meet the projected maximum day demands until 2015. At the same time, capital improvements would be delayed until 2015. The debt service for the capital investments would (hypothetically) be paid over the 20-year period between 2015 and 2035. The cumulative annualized costs of this delayed strategy would be approximately $110M.

Figure 1C illustrates a hypothetical approach to phasing the capacity increase. This phased approach to expanding Elkhart's water supply could include:

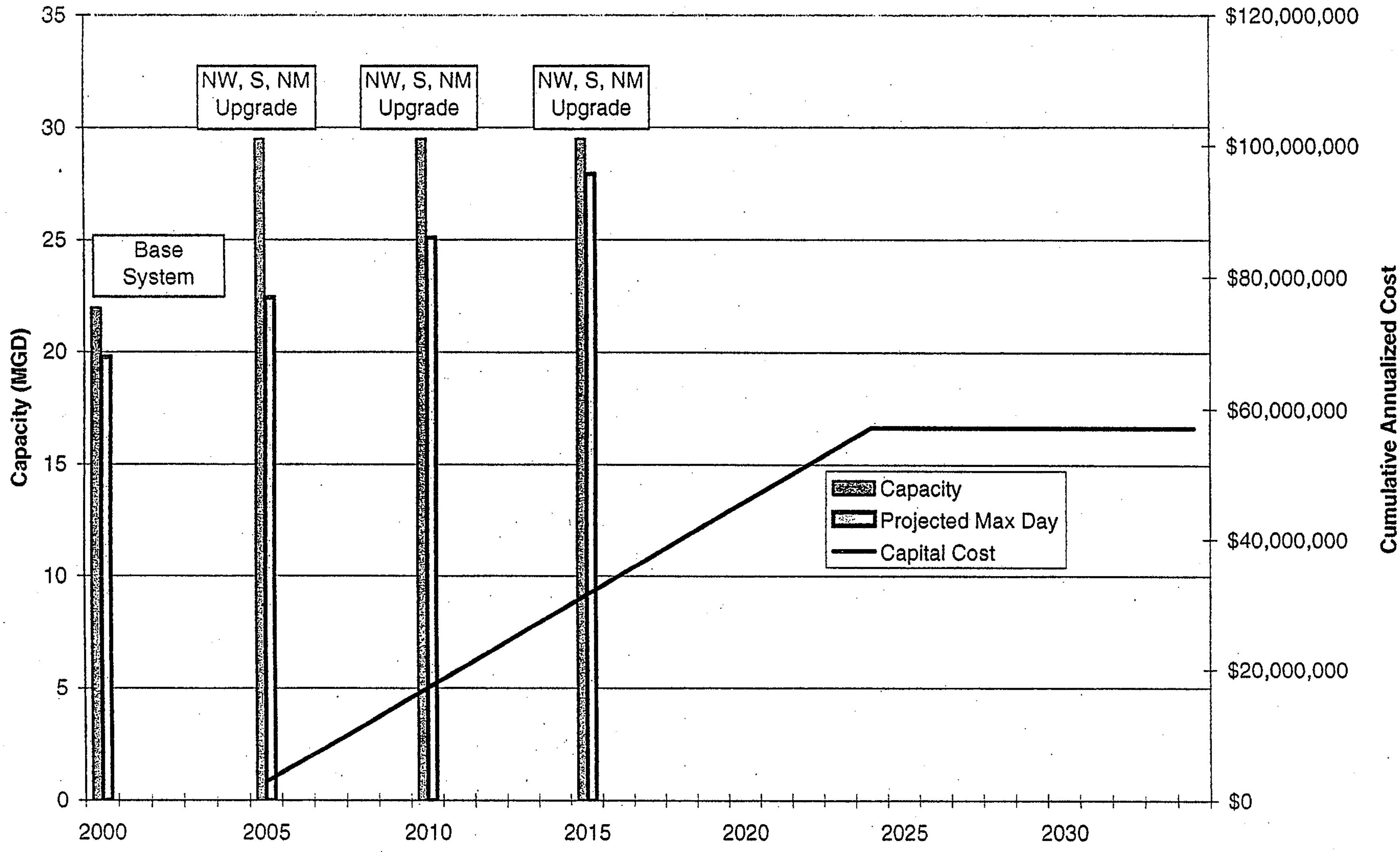
- Upgrading the Northwest Well Field in 2005
- Expanding the South Fell Field in 2010
- Upgrading the North Main Street Well Field in 2015

Phased capacity increases. This hypothetical improvement plan would progressively increase the system firm capacity such that the projected maximum day demands would be consistently met over the planning period. The debt service for the capital investments would (hypothetically) be paid over the 20-year period between 2005 and 2025, with the debt increasing incrementally in 2010, and in 2015. The cumulative annualized costs of this phased investment strategy would be approximately $66M.

3.0 MASTER PLANNING FOR EFFICIENT AND EFFECTIVE CAPITAL INVESMENTS

As mentioned previously, the goal of the Water System Master Plan is to develop a CIP for the Elkhart Water System. The appropriate timing for and the actual sequence of the capital improvements will depend upon the results of the distribution system hydraulic modeling. In addition, capital investment analyses such as the hypothetical cases presented here, will be performed where appropriate to determine the optimum cost-benefit approach to upgrading and expanding Elkhart's water system.

Figure 1A: 2005 Expansion of Elkhart's Water Supply



<u>Figure 1B</u>: 2015 Expansion of Elkhart's Water Supply

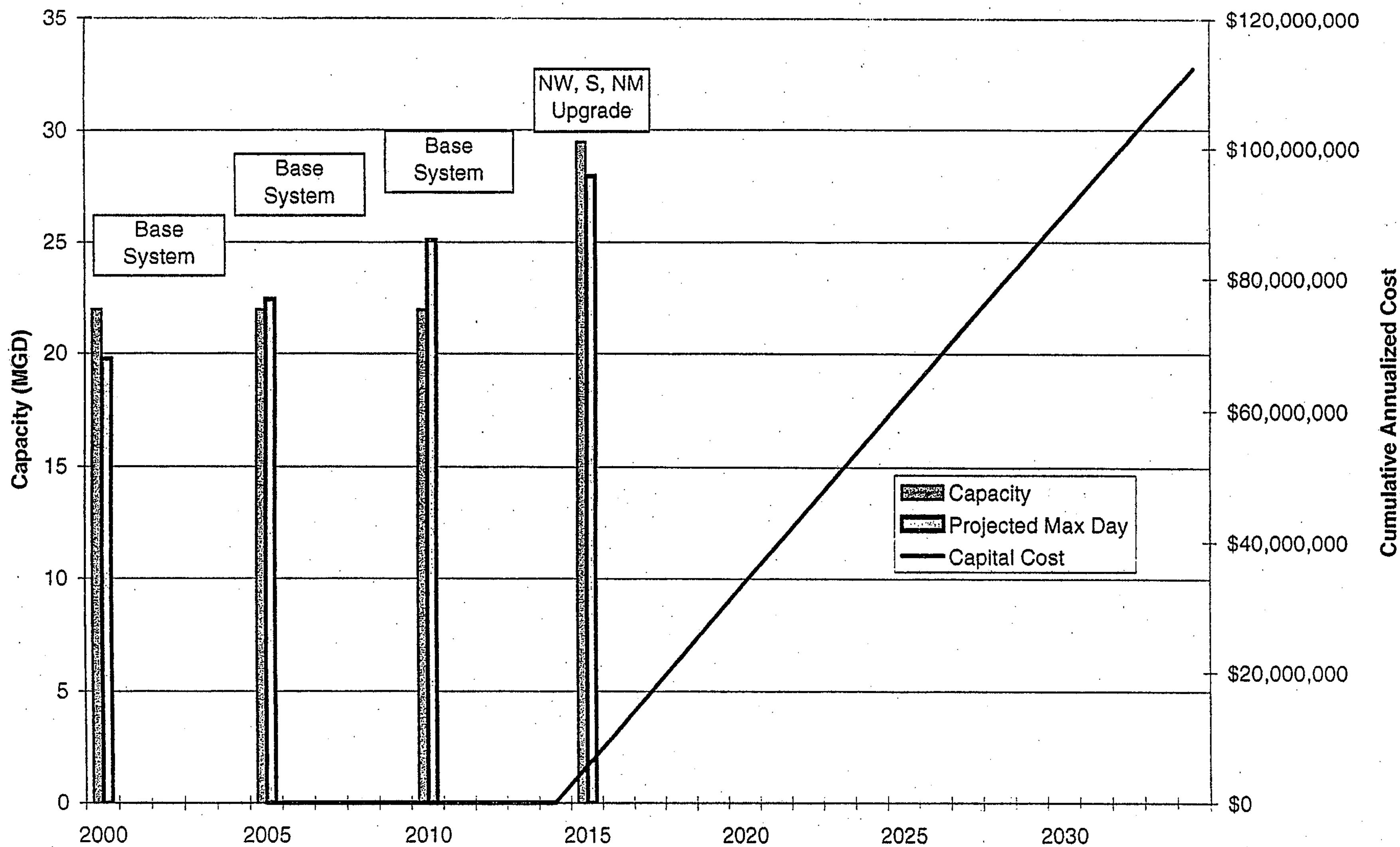
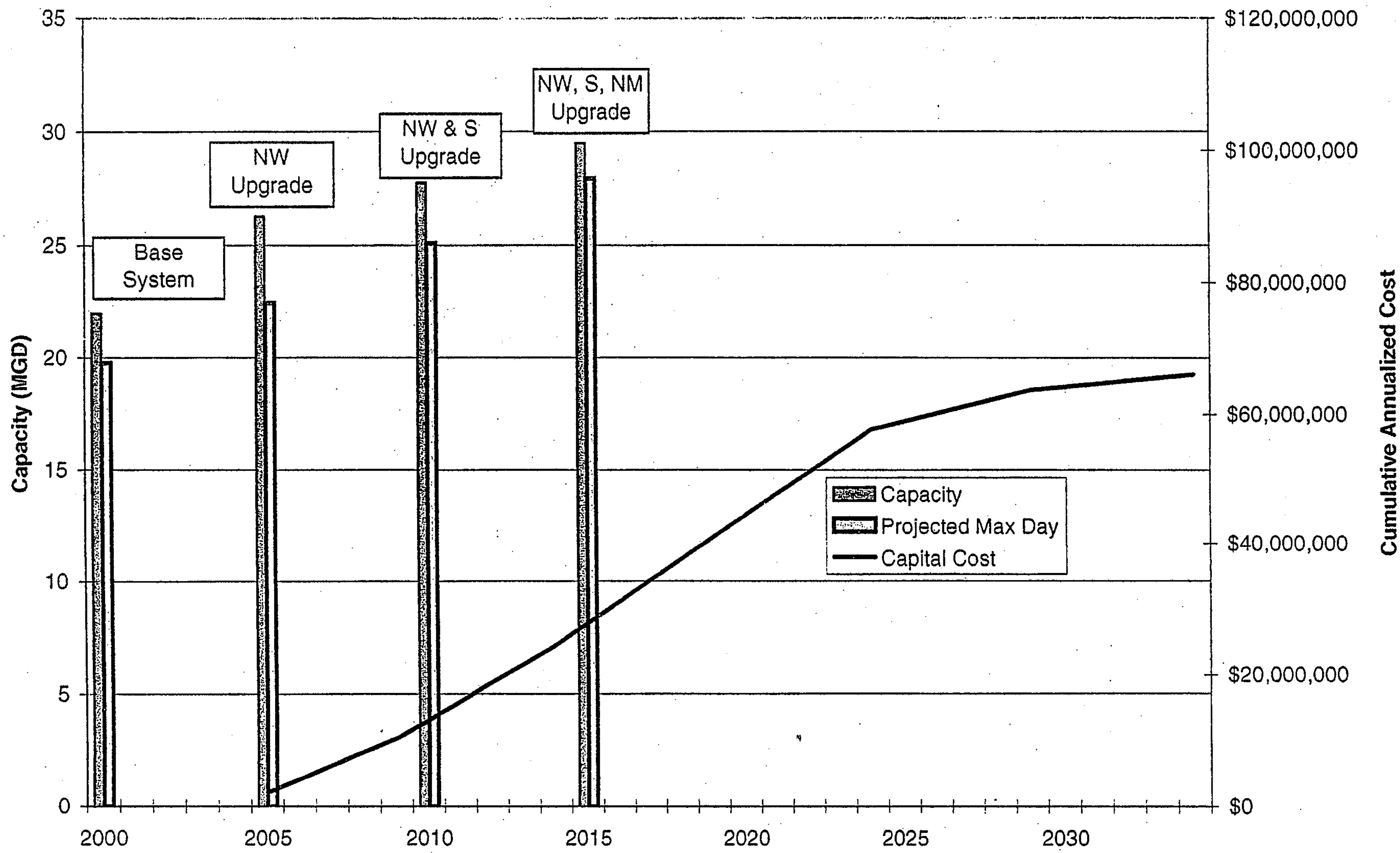


Figure 1C: Staggered Expansion of Elkhart's Water Supply



CITY OF ELKHART
WATER MASTER PLAN

A SUMMARY OF CASE STUDIES AND RECOMMENDATIONS FOR IMPLEMENTING "BEAT-THE-PEAK" STRATEGIES

JANUARY 2000

Document Prepared By:

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1.0 INTRODUCTION

Decreasing maximum water demands can provide economic benefits to utilities and their customers by downsizing or postponing the need for capital projects. Some communities have developed and implemented water conservation programs as a strategy for slowing or controlling increases in maximum day water use; in some cases, these are referred to as "beat-the-peak" programs. Implementing a water conservation program can be a challenge, particularly in Midwestern communities where water is perceived as plentiful.

This technical memorandum has been prepared to describe beat-the-peak type programs that have been implemented in other communities. Suggestions for initiating a beat-the-peak program in Elkhart are summarized at the conclusion of this report. *Note:* In this report, the terms "peak day" and "maximum day" are used interchangeably.

One of the mission statements for the Elkhart Water Utility is "*to serve as a steward of our water resource for future generations.*" Promoting efficient use of existing water supplies through conservation planning is one strategy for achieving that mission.

2.0 CONSERVATION PLANNING

Currently, the State of Indiana does not require the public water systems to file conservation plans. However, conservation planning helps public water systems develop effective and goal-oriented water conservation strategies. Planning can be especially beneficial to water systems that are trying to reduce long-term capital improvement costs, and will help promote the efficient use of existing water resources.

The 1996 Amendments to the Safe Drinking Water Act (SDWA) required the United States Environmental Protection Agency (EPA) to publish guidelines for water utilities to use in preparing a water conservation plan. These guidelines were published by EPA on August 6, 1998 and are available on the web at http://www.epa.gov/owmitnet. * At their discretion, states may require water systems applying for Drinking Water State Revolving Fund (SRF) loans to submit a conservation plan as a condition of receiving a loan. The Water Conservation Plan Intermediate Guidelines (for systems serving 10,000 – 100,000 customers) includes the following steps:

- Specify conservation planning goals
- Develop a water system profile
- Prepare a demand forecast
- Describe planned facilities
- Identify conservation measures
- Analyze benefits and costs
- Select conservation measures
- Integrate resources and modify forecasts
- Present implementation and evaluation strategy

The first four of these steps are phases of the master planning process, so the evaluation of possible conservation strategies for reducing peak-day demands is timely.

Some funding for technical assistance to water systems may be available through the State Revolving Fund (SRF). However, the state of Indiana does not carry out any water conservation activities according to a 1997 survey of state water conservation programs (42 of the 50 states responded to the survey).[1]

[1] Miri, Joseph A. "A Snapshot of Conservation Management: 1998 Survey of State Water Conservation Programs". WaterWiser/AWWA, 1999.

3.0 BEAT-THE-PEAK CONSERVATION STRATEGIES

Many conservation strategies are available and are used by water utilities across the country. Conservation strategies can vary from public education to alternative rate structures for water users. With all strategies, the ultimate goal of water conservation is efficient use of existing water supplies.

The EPA Conservation Guidelines include a checklist of conservation measures for medium sized utilities such as Elkhart. This worksheet provides an excellent list of potential conservation measures for Elkhart's consideration (Worksheet 4-8, attached).

Many of the Level 1 Conservation Measures suggested by the EPA on Worksheet 4-8 have already been implemented by the City of Elkhart (e.g., universal metering, water accounting loss and control, and information and education programs). To develop a beat-the-peak conservation program for Elkhart, some advanced Level 1 as well as Level 2 and Level 3 measures should be considered. A brief description of measures that could be evaluated by Elkhart for implementation follows.

3.1 Public Information and Education

Public information and education programs are the most popular types of water conservation activity. According the 1997 survey, 30 states participate in some form of water conservation outreach and/or technical assistance (Miri 1998). Since this is a non-regulatory activity, it has received wide acceptance as a conservation tool. Some examples of information and education measures that could be used to promote efficient water use include:

- Water bill inserts promoting conservation to customers
- Public education programs

Worksheet 4-8: Checklist of Conservation Measures [a]

Measure [a]	Already implemented ☑	Plan to implement ☑	Comments [b]
LEVEL 1 MEASURES			
Universal metering [B]			
Source-water metering	☐	☐	________
Service-connection metering	☐	☐	________
Meter public-use water	☐	☐	________
Fixed-interval meter reading	☐	☐	________
Meter-accuracy analysis	☐	☐	________
Test, calibrate, repair, and replace meters	☐	☐	________
Water accounting and loss control [A]			
Account for water	☐	☐	________
Repair known leaks	☐	☐	________
Analysis of nonaccount water	☐	☐	________
Water system audit	☐	☐	________
Leak detection and repair strategy	☐	☐	________
Automated sensors/telemetry	☐	☐	________
Loss-prevention program	☐	☐	________
Costing and pricing [B]			
Cost-of-service accounting	☐	☐	________
User charges	☐	☐	________
Metered rates	☐	☐	________
Cost analysis	☐	☐	________
Nonpromotional rates	☐	☐	________
Advanced pricing methods	☐	☐	________
Information and education [B]			
Understandable water bill	☐	☐	________
Information available	☐	☐	________
Informative water bill	☐	☐	________
Water-bill inserts	☐	☐	________
School program	☐	☐	________
Public-education program	☐	☐	________
Workshops	☐	☐	________
Advisory committee	☐	☐	________
LEVEL 2 MEASURES			
Water-use audits [B]			

Audits of large-volume users	☐	☐	______
Large-landscape audits	☐	☐	______
Selective end-use audits	☐	☐	______
Retrofits [B]			
Retrofit kits available	☐	☐	______
Distribution of retrofit kits	☐	☐	______
Targeted programs	☐	☐	______
Pressure management [A]			
Systemwide pressure regulation	☐	☐	______
Selective use of pressure-reducing valves	☐	☐	______
Landscape efficiency [P]			
Promotion of landscape efficiency	☐	☐	______
Landscape planning and renovation	☐	☐	______
Selective irrigation submetering	☐	☐	______
Irrigation management	☐	☐	______
LEVEL 3 MEASURES			
Replacements and promotions [B]			
Rebates and incentives (nonresidential)	☐	☐	______
Rebates and incentives (residential)	☐	☐	______
Promotion of new technologies	☐	☐	______
Reuse and recycling [B]			
Industrial applications	☐	☐	______
Large-volume irrigation applications	☐	☐	______
Selective residential applications	☐	☐	______
Water-use regulation [B]			
Water-use standards and regulations	☐	☐	______
Requirements for new developments	☐	☐	______
Integrated resource management [B]			
Supply-side technologies	☐	☐	______
Demand-side technologies	☐	☐	______

[a] For more information about measures see Appendix A. Non-italicized measures should be considered at a minimum.
[b] Note special issues related to the measure, including legal or other obstacles precluding implementation.
Note: Measures can affect average-day demand [A], maximum-day (peak) demand [P], or both [B], as indicated.

- School curriculum materials or programs on conservation
- Conservation workshops and seminars
- Forming a conservation advisory committee

3.2 Alternate Water Rates

Water utilities are implementing more conservation-oriented water rate structures to help promote efficient water use. Currently, the City of Elkhart uses a declining-block rate structure: the more water consumed the lower the rate charged per gallon of water. The following are examples of alternate rate structures that promote conservation:

- Uniform Commodity Rates – all water use is charged at the same unit rate. This rate structure is not always considered conservation-oriented, but it is an improvement over a declining-block rate structure and provides an interim step for water systems moving away from an existing declining-block rate structure.

why?

- Flat Seasonal Rates – incorporates two or more different uniform volume charges for different seasons during the year. Generally a higher rate is charged for water during the peak season than is charged during the off-peak season.

- Inverted-Block Rates – increases rates for units of water consumption at higher levels of use. Customers that use minimum units of water will benefit, while customers that consume numerous units of water will pay increasingly higher rates for their water.

How does this impact or attract industrial users?

- Excess-Use Rates – base water use is defined as the average use during a certain nonpeak period and is charged at a base rate. During a peak period or season, water use above some percentage of the base level is charged at the base rate plus an excess-use rate.

3.3 "Feebates"

The "feebate" is a combination of fees and rebates. It combines the uniform rate structure with use allotment and either fees or rebates depending on water consumption. The idea is to establish a uniform rate that achieves revenue neutrality (i.e. the revenue neutral rates are solely based on the water system's costs). The water system then devises an allotment program, which entitles customers to a certain amount of water each month at a uniform rate per unit. Then the feebate plan is administered by the water system as desired. Feebates apply when a customer's actual use varies from their allotments. The customer receives a rebate if they consume less than their allotted units of water and a fee, in addition to the uniform flat rate, for consuming more than their allotted units of water.[2]

Is the "fee" increased with uses above various thresholds?

The concept of feebates is not new. For example, California has a "Drive+" proposal where the buyers of cars that get relatively few miles to the gallon would be assessed extra fees to pay for rebates to buyers of other cars that get relatively high miles per gallon. As of 1996, a feebate plan has not been implemented in its entirety by a water utility. However, the Sun City Water Company (SCWC) in Arizona has adopted a similar plan. Under its rate structure, a customer's past use forms a baseline above which a 25 percent surcharge is added or below which a 25 percent discount is offered. Baselines are updated annually.[3]

3.4 Landscape Efficiency Programs

Landscaping accounts for 20-50% of all residential water use. Programs that promote landscape efficiency will focus specifically on reducing the peak day water demand and can also affect seasonal usage. Programs can include media campaigns, workshops, and direct mailings and bill inserts focusing on:

- Reduced/optimized lawn watering
- Sprinkler system maintenance
- Efficient irrigation
- Lawn height
- Use of mulches
- Plant selection

[2] Collinge, Robert A. 1996. Conservation feebates. *Journal AWWA*, 88: 70-78.
[3] Collinge, Robert A. 1996. Conservation feebates. *Journal AWWA*, 88: 70-78.

- Soil preparation

Of the items listed on EPA's *Checklist of Conservation Measures* (Worksheet 4-8), landscape efficiency programs are the only programs that specifically target reduction of maximum-day demand.

3.5 Water Use Regulations or Restrictions

Water use regulations are another way to decrease the peak demand. To reduce maximum-day demand, the regulations could restrict water use during the summer months. For example, restrictions could be placed on the time of day customers could water their lawns. Also, car washing on residential property could be prohibited during the summer months.

Other types of water use regulations could include conservation-oriented plumbing codes. Some communities have implemented requirements that all new construction include water-efficient fixtures such as low-flow showerheads and low-flow toilets. However, some debate the effectiveness of these codes because the manufacturers typically only offer low-flow fixtures anyway; that's all that is available for the contractors to purchase.

4.0 CASE STUDIES

The majority of the Midwestern States have not implemented any conservation strategies. The exception is Illinois, which has a conservation plan.

4.1 Boise Water Corporation (BWC)[4]

In 1996, a case study for water conservation by the BWC, a private company, was published. BWC's incentive to conserve was to avoid the capital-cost associated with a water treatment plant expansion to meet future customer demands. In addition, BWC was directed by the Idaho Public Utilities Commission to develop a conservation plan, the first in the state.

BWC owns an 8-mgd water treatment plant that serves a population of 170,000 people. The anticipated water use increase from 1993 to 2005 was 33%. Twenty different conservation measures were evaluated and four were found to be cost-effective for BWC. The cost-effective measures included: 1) leak detection and repair of piping in the plant and the distribution system, 2) modification of plumbing codes to include water efficient fixtures, 3) public education regarding water-related issues, and 4) residential water audits to help customers reduce waste and lower their water bill.

Describe the residential water audit process

4.2 Phoenix Water and Wastewater Utility (PWWU)[5]

The PWWU promotes water conservation with its rates. The following is the history of the PWWU's rate structure:

- prior to 1977 – uniform rate structure
- 1977 – inverted-block rate structure, with two blocks
- 1982 – a third block was added
- 1989 – seasonal, three-block rate structure
- 1990 – three-season, uniform rate structure (each season 4 months in length)

[4] Maddaus, W.O., Gleason, G., and Darmody, J. (1996) Integrating conservation into water supply planning. *Journal AWWA*, 88: 57-67.
[5] Cuthbert, R.W., and Lemoine, P.R. (1996) Conservation-oriented water rates. *Journal AWWA*, 88: 68-78.

A review of residential water use in Phoenix shows a consistent long-term trend toward reduced water use from 1975 to 1994. Average monthly water use has declined in the summer months nearly 30 percent and average winter use has declined nearly 25 percent over this 19-year period. A 1994 study of water use in Phoenix concluded that the new seasonal rate structure implemented in 1990 had been effective in reducing average residential water use between 1.0 and 1.6 percent over the first three years the structure was in effect.

4.3 Seattle Water Department (SWD)[6,7]

In Seattle, peak demand is dominated by landscape water use. In order to "beat-the-peak", Seattle has launched a summer campaign consisting of TV, radio, and print media to influence water consumption. The public information campaign in the summer consists of:

- Lawn watering efficiency
- Demonstration gardens (how to select plants that doesn't require much water, how to aerate and fertilize the soil to retain moisture content, etc.)
- Workshop and speaking tours
- Direct mailings and bill inserts
- Short messages on water bills including printed consumption histories
- Zoning and landscape codes

The history of the SWD rate structure is as follows:

- prior to 1989 – uniform rate structure

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[6] Cuthbert, R.W., and Lemoine, P.R. (1996) Conservation-oriented water rates. *Journal AWWA*, 88: 68-78.

[7] Dietemann, A. (1999) A peek at the peak, case study: reducing Seattle's peak water demand. AWWA/WaterWiser.

- 1989 – inverted-block rate structure, the winter rate remained uniform but the summer rate became a two-step inverted-block rate structure

Since 1989, the SWD has increased its rates four times, still using the seasonal inverted-block structure. Average monthly use in the summer months has declined 4.5% and average winter months have declined 8% over this 18-year period.

4.4 Tucson Water Department (TWD)[8]

TWD also promotes conservation with its water rates. The following is the rate-structure history for the TWD:

- 1977 – seasonal inverted rate structure, winter rate was uniform but the summer rate was a four-block rate structure
- 1978 – 1992 – increased the number of blocks and the differentials of the various block rates; also implemented a similar inverted-block rate structure during the winter
- 1993 – excess-use rate structure implemented
- 1995 – three-block inverted rate structure implemented, in effect year-round

The TWD received numerous complaints regarding the excess-use rate structure that was implemented in 1993. The city council voted to return to a simpler three-block inverted rate structure. Average monthly water use in the summer months declined 9% and average winter use increased about 2% between 1977 and 1993. It should be noted that Tucson began the 16-year period with an already lower than average residential water use level, which may provide less opportunity for conservation savings.

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[8] Cuthbert, R.W., and Lemoine, P.R. (1996) Conservation-oriented water rates. *Journal AWWA*, 88: 68-78.

4.5 Denver Water[9]

Denver Water created a Conservation Master Plan detailing the goals they want to achieve and the strategies required to achieve those goals. The following is a list of strategies from their conservation master plan:

- Provide more information and incentives to stimulate the market for water-efficient appliances
- Offer incentives to reduce over-watering of landscapes
- Convert traditional landscapes to Xeriscape
- Provide more information on the benefits of Xeriscape
- Provide technical assistance in converting existing landscapes to Xeriscape
- Innovative school education programs focusing on water-related topics
- Instructional water conservation television advertisements
- Leak detection at the plant, technicians survey every inch of pipe every three years using acoustic instruments

5.0 SUMMARY AND RECOMMENDATIONS

The most important factor in developing a successful conservation program/plan is public acceptance. If the customers are not willing to accept the consequences of a conservation program, then the program will probably not succeed in the long run. Therefore the following factors should be taken into consideration when considering a conservation plan/program:

- Gradual or phased implementation

[9] Office of Water Conservation. (1997) Denver Water Conservation Master Plan. Denver Water, 1600 West 12th Avenue, Denver, CO 80254-0001.

- Public involvement

- If rates are modified, they should be based on cost of service

The following measures have the potential to reduce the peak day demand (i.e., implementing a Beat-the-Peak program) in Elkhart and should be evaluated:

1. Encourage wise water use by developing and implementing a landscape efficiency program and

2. Expanding public information and education programs to include "beat-the-peak" best practices (e.g., water efficient plants, appropriate lawn watering times) to encourage wise water use.

3. Rate-structure alternatives, particularly those that reflect cost-of-service, for the near-term.

4. Conservation-oriented rate structures for the future, should the voluntary conservation efforts through public information and education programs not prove effective.

Section 10
Appendix C

MALCOLM PIRNIE

INTEROFFICE CORRESPONDENCE

To:	Art Umble, Manager, City of Elkhart, IN Michael Machlan, Network Engineer, City of Elkhart, IN	**Date:** 12/07/2000
Copy:	Tarlochan Bhullar, Malcolm Pirnie, Detroit, MI Melissa Moran, Malcolm Pirnie, Indianapolis, IN	
From:	Chris Ranck, Indianapolis, IN	
Re:	Conversion of WaterCAD Model Results to GIS Importation of GIS data to WaterCAD	

This technical memorandum outlines the procedures for displaying WaterCAD pressure contours in ArcView, importing GIS data into WaterCAD, and the synchronization of coordinates between the GIS and the model.

1.0 EXPORTATION OF PRESSURE DATA

If Access 97 is being used for database applications, the following line must be added to the Haestad.ini file in the C:\Haestad folder.

ConnectionDatabaseFormat=3

1.1 SETTING UP A DATABASE CONNECTION

Creating a database connection in WaterCAD will only have to be done once. From the File menu in WaterCAD, select Synchronize → Database Connections. Select [Project Export – US] and click on "Duplicate." When the connection pops up, assign a meaningful connection label such as "Pressure Export."

Delete all but one of the ten Table Links that are listed. Edit this link. Change the Database File to "elkhartwater.mdb," the database provided with this memo. The function of this database is to handle the transfer of data. Select "Pressure Output" as the Database Table. The table type is "Pressure Junction," and the Key/Label Field is "Junction ID." Delete all but one of the "Field links" that are listed below. Set the WaterCAD and Database fields to "Pressure" for this link, and the units to "psi." Click on "OK" twice to get back to the Database Connection Menu Manager.

This connection may be modified in the future to export additional data, such as total demand, if necessary. Screen shots of a sample database connection are attached.

1.2 USING THE DATABASE CONNECTION

Pressures will be exported for a *single time step* in the model only. Make sure the desired time (00:00, 12:00 etc) has been selected.

From the Database Connection Manager, select the "Pressure Export" connection and click on "Synchronize Out." This will send the pressures from the selected time step into the database. Existing pressures in the database will be overwritten.

1.3 SETTING UP AND USING AN ODBC CONNECTION IN ARCVIEW
Creating a database connection in ArcView will only have to be done once. Open the ArcView project that you want to see the pressures in. Make sure "Database Access," is a selected Extension.

From the "Project" Menu, select "Add Database Table." Make sure "ODBC" is selected in the upper right hand corner and click on the icon next to "Create a new Connection." Click "New" from the menu that pops up. Select "Microsoft Access (.mdb) Driver," and give the connection a meaningful name such as "Pressure Export." Click "Finish," and save the file. Click on "Select" on the next menu that pops up and select "ElkhartWater.mdb," the database that was provided.

From the Database Table menu, double click on both "Pressure Output," and "All Columns." You may want to give the table a different name than "Table 1." Click on "Query," to import the table.

Open the database table for the model nodes. First highlight the "Junction ID" field in the newly imported table, then highlight the same field in the node table. From the "Table" menu, select the "Join" command.

You now have pressure data from the Access database linked to the Model node shapefile in ArcView. This data may not be edited in ArcView, but it will be automatically updated whenever future data exports from WaterCAD are made. Screen shots of a sample database connection are attached.

__Note:__ ArcView reads from attached databases only when the project is opened or when edits are made to the shapefile of interest. If the ArcView project is open during the WaterCAD data export, make sure the data updates by selecting "Start Editing," and then "Stop Editing," on the model node shapefile.

1.4 USING ARCVIEW SPATIAL ANALYST.
Make sure "Spatial Analyst" is a selected Extension. With the Model node shapefile active, select "Interpolate Grid," from the "Surface Menu." Click "OK," and make sure the Z-value field is set to "Pressure" in the next menu.

The newly created pressure surface may be edited to any color scheme or interval that is desired. 3D Analyst could be used to convert the surface to a TIN and generate a relief map.

2.0 IMPORTATION OF GIS INFORMATION INTO WATERCAD

In a similar fashion to Section 1.1, a "Project Import" Database Connection can be set up to read in any information from an established database. The following section addresses the coordinate systems used in WaterCAD and GIS.

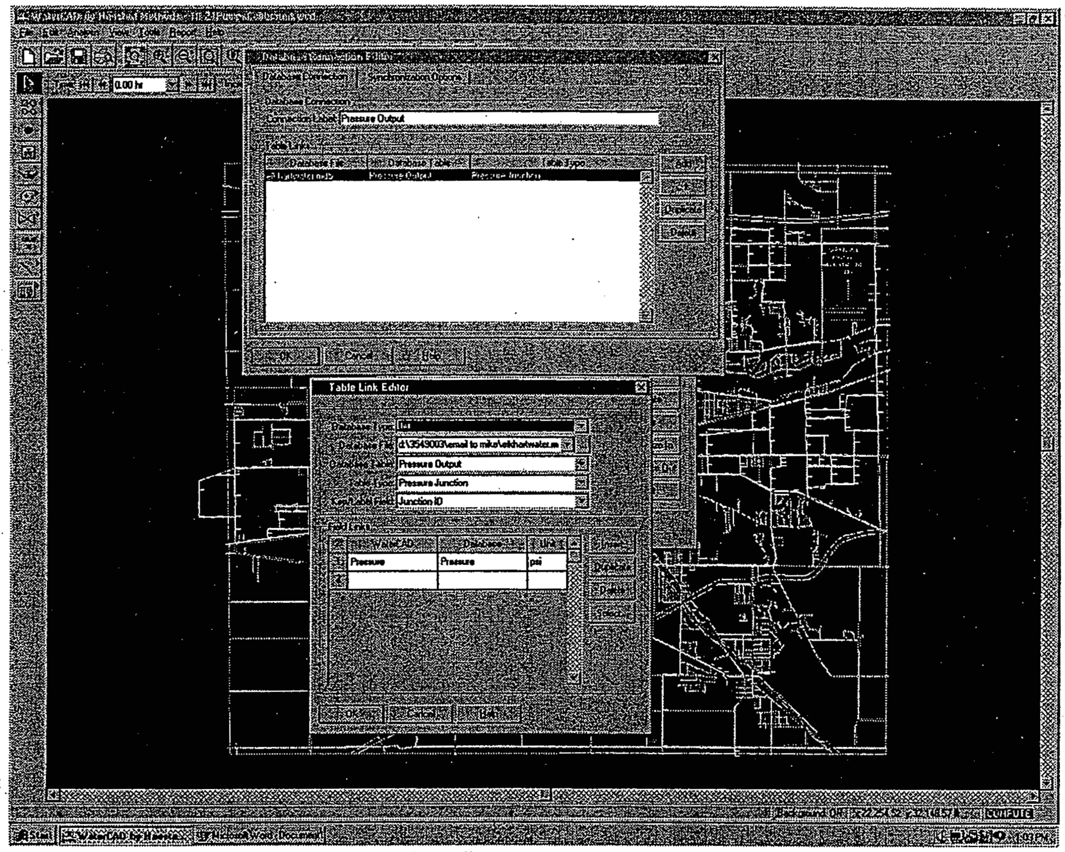
2.1 COORDINATE CONVERSION OF JUNCTIONS

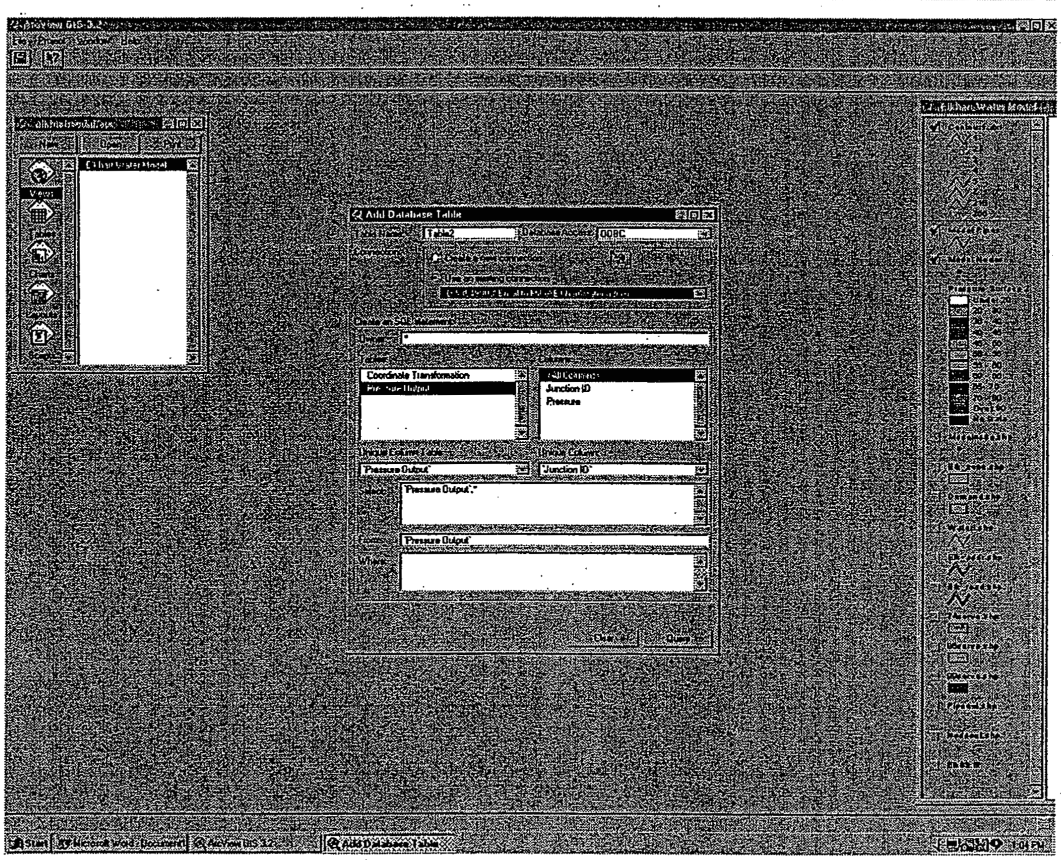
Matching coordinates in WaterCAD to the GIS can be accomplished by using an Import Database Connection. The procedure is nearly identical to Section 1.1, except the file will read in from the "Coordinate Transformation" table in the database. "Final X," and "Final Y" fields *in feet* should be read in to the X and Y fields of the model junctions. Use "Synchronize In" to update the coordinates.

It should be noted that this process does not move any pipe bends in the system, or any recently added pumps or valves in the well fields. These will have to be moved manually.

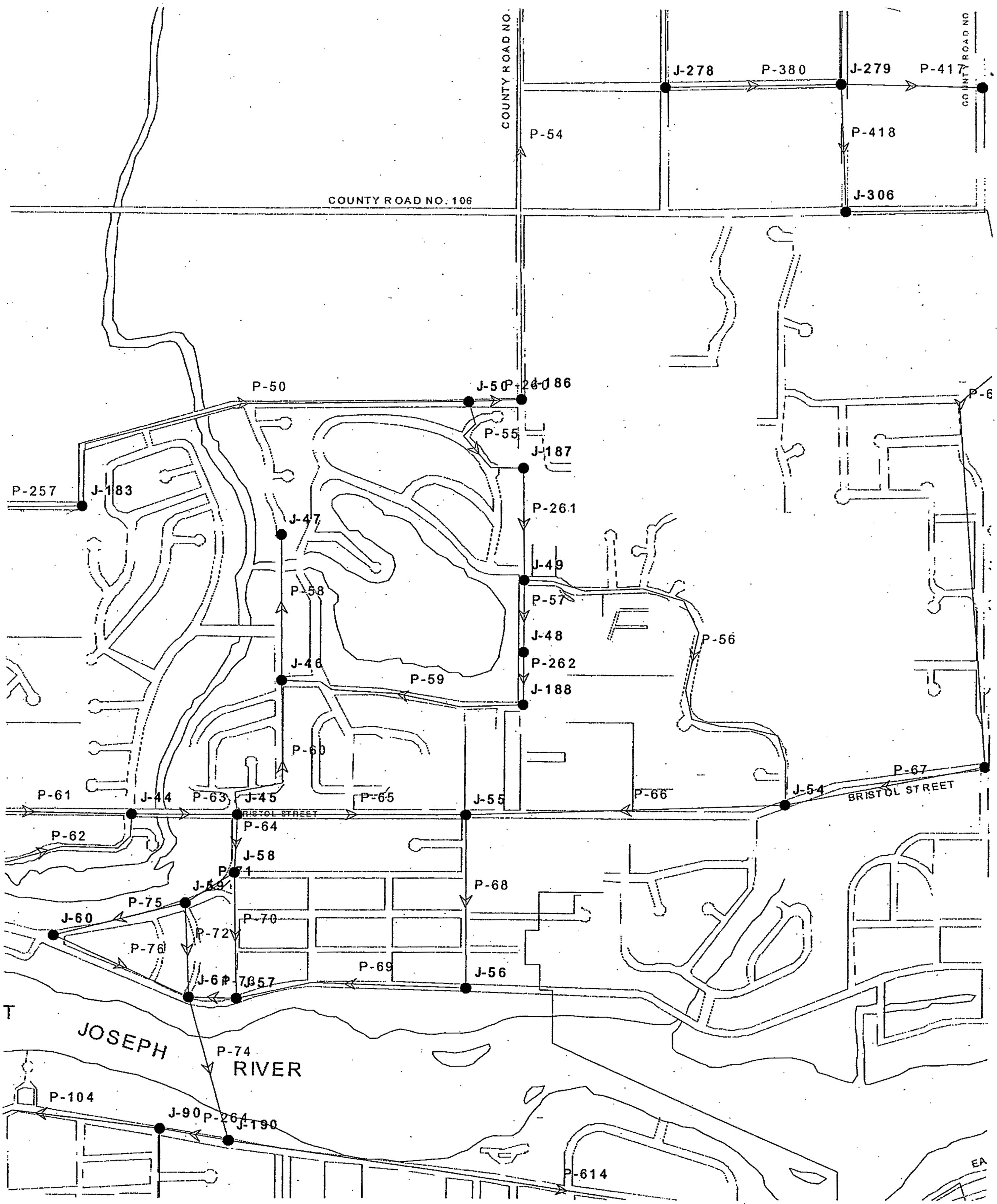
With the changes made in this step, pressure contours generated in WaterCAD can be exported as a .dxf-file and read into ArcView, provided the "Cad Reader" extension is selected.

SAMPLE DATABASE CONNECTIONS

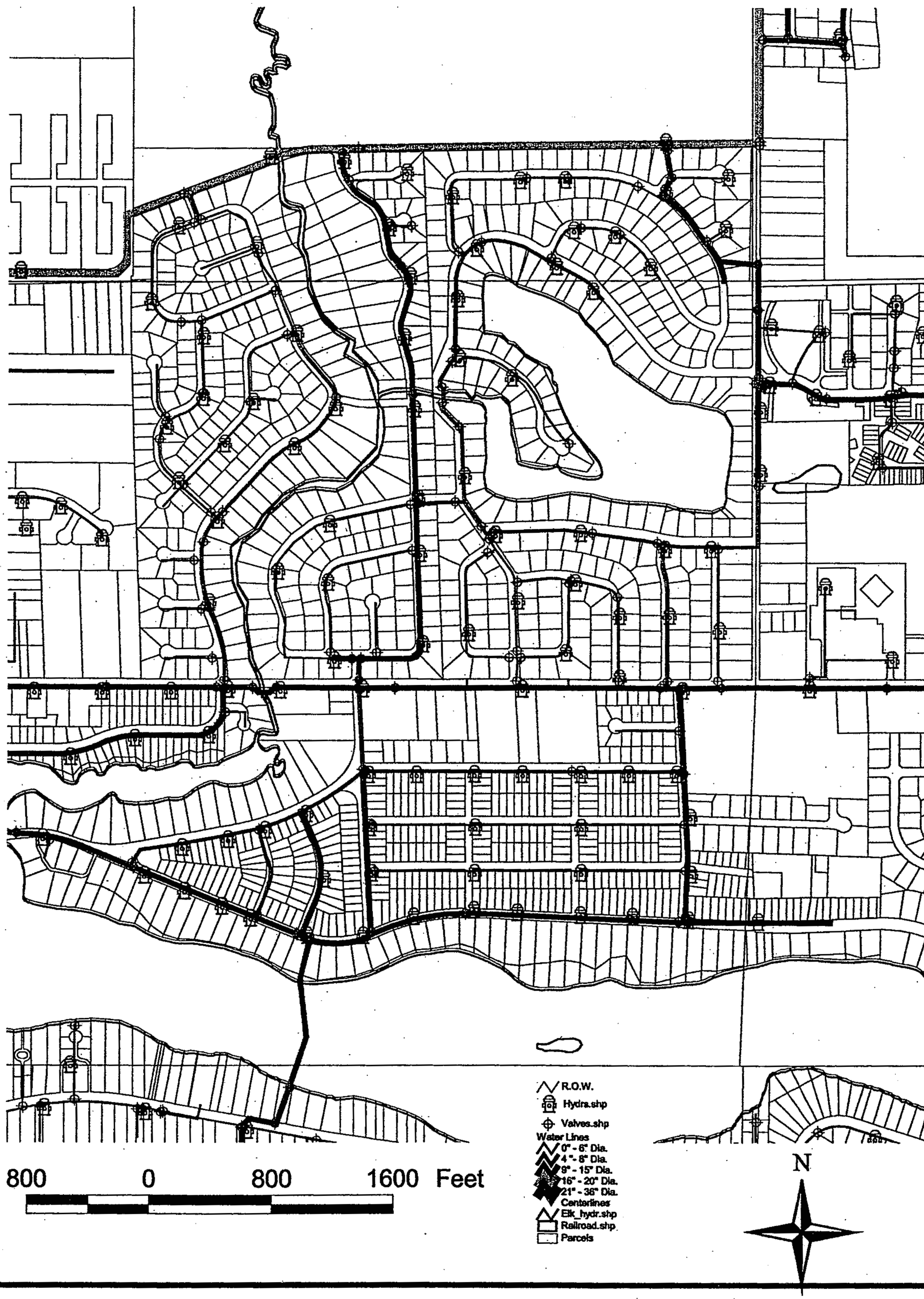




Scenario: 1999 Pipes with 2005 Demand



Water System and Census Information
Near East Lake Estates



MALCOLM PIRNIE

INTEROFFICE CORRESPONDENCE

To: Art Umble, Manger, City of Elkhart, IN **Date:** 11/27/200
Michael Machlan, Network Engineer, City of Elkhart, IN

Copy: Melissa Moran, Malcolm Pirnie, Indianapolis, IN
Chris Ranck, Malcolm Pirnie, Indianapolis, IN

From: Tarlochan Bhullar, Malcolm Pirnie, Detroit, MI

Re: City of Elkhart Water Distribution System Model Information Review and Calibration Technical Memorandum

This technical memorandum describes the review of existing model information and calibration of the dynamic model for historical maximum day demand period.

REVIEW OF MODEL INFORMATION

Junction and pipe information was exported from the existing WaterCAD model into GIS. The exported model GIS shapfiles information was verified with the existing water distribution system GIS information provided by the City of Elkhart. The following differences between the model shapefiles and Elkhart's GIS are summarized:

- Unmatched demand from Junction 462 was assigned to Junction 441 since 462 were not in the existing model.
- Connectivity and location for Junctions 280, 281, 282, and 345 in the model did not match the GIS. All four of the junctions were moved, the length to Pipe 468 was adjusted, and Pipes 607 and 608 were added to the model.
- Matched demand from Junctions 460 and 461 were assigned to Junction 54 since these junctions were not in the existing model.
- Junctions 309 and 437 were connected with Pipe 609, 1000' of 12" pipe with a C-value of 110.
- Junctions 309 and 429 were connected with Pipe 612, 3000' of 12" pipe with a C-value of 110.
- Junctions 306 and 53 were connected with Pipe 613, 7000' of 10" pipe with a C-value of 110.
- Junctions 190 and 191 were connected with Pipe 614, 5800' of 6" pipe with a C-value of 90.

MODEL CALIBRATION APPROCH

The model calibration process's main objective was to match the model predicted flow and pressure with recorded pressure and flow data at the well field locations and elevated storage tanks. Recorded historical maximum demand day data for June 9, 1999 was used for model calibration.

Two system parameters; pipe roughness coefficient and model node demand were identified as main parameters for the model calibration. Adjustment of Hazen-Williams C-values and the change in demand assigned to model nodes was used to calibrate model for the City of Elkhart.

A 3rd model input parameter; ground elevation information was verified using USGS contour map. The recorded pressure data for model calibration was available only at the elevated storage tanks. The verification of tank height above the ground elevation was important information. The City of Elkhart provided the tank design information and USGS contour map. However, the ground elevation information at the storage tank elevations was missing in the provided tank design information. The USGS contour map provided by the City of Elkhart was used to supplement this missing ground elevation information at the elevated storage tanks. The ground elevation information at selective model node locations was also verified with USGS map.

Hazen-Williams coefficients were locally adjusted to better match the known pressures and flows around the calibration points. Demand was shifted from the residential patterns to commercial patterns to better match the overall system demand pattern. The USGS map was used as a source of information to identify commercial and educational institutes in the service area. The unmatched demands were shifted from one junction to another junction to match pressure and flows.

MODEL CALIBRATION PROCEDURE:

CALIBRATION STEP 1: Prior to commencing model calibration, several updates to the model were made.

- Demands allocated by the GIS analysis were attached to the model junctions in GIS and imported into the WaterCAD model. The model node demands have been classified as GIS matched residential, unmatched residential and matched commercial. These demands are summarized in attached Table A.

- Hourly flows were made input from all the well fields based upon the pump log information provided by the City of Elkhart for the selected historical maximum day June 9, 1999. This step was carried out to remove a dimension of complexity from the modeling of well fields and make calibration process easier.

- Table 1, contains the hourly inflow patterns for the three well fields. These flow and flow patterns are based on the analysis of pump log records for the maximum day demand on June 9, 1999. Inflows were added at discharge Junction on Northwest well field, South well field, and North Main well field.

Table 1 - Well Field Patterns

Time	Well Field Patterns		
	North Main	South	North West
12:00 AM	0.47	0.90	1.10
1:00 AM	0.47	0.90	0.00
2:00 AM	0.32	0.90	0.00
3:00 AM	0.47	0.90	0.57
4:00 AM	0.47	0.90	0.57
5:00 AM	0.99	1.20	1.10
6:00 AM	1.40	1.20	1.68
7:00 AM	1.40	0.90	1.68
8:00 AM	1.40	0.60	1.68
9:00 AM	1.40	0.60	1.68
10:00 AM	1.40	0.60	1.68
11:00 AM	1.40	0.90	1.68
12:00 PM	1.02	1.20	1.68
1:00 PM	1.02	1.20	1.10
2:00 PM	1.02	1.20	1.10
3:00 PM	1.02	1.20	1.10
4:00 PM	1.02	0.90	1.10
5:00 PM	1.02	0.90	1.68
6:00 PM	1.33	1.20	0.00
7:00 PM	1.33	1.20	0.00
8:00 PM	1.33	1.20	0.00
9:00 PM	1.33	1.20	1.68
10:00 PM	0.47	1.20	0.57
11:00 PM	0.47	0.90	0.57
Average Flow (mgd)	**11.06**	**3.33**	**2.18**

- Model node demand patterns (diurnal) for residential and commercial customers were assigned. The residential patterns were assumed to be identical to the system wide diurnal pattern, which was calculated from hourly pump and tank flow data on June 9, 1999. The commercial patterns were synthetically assembled based upon assumptions for hours of commercial operation. A plot of these patterns can be found in attached Figure 1.

- The Northwest, South, and North Main well field pump schematics were reviewed and updated based upon the hard copy schematic information provided by the city of Elkhart.

- The four elevated storage tanks in the system (Benham, Bower, Riverview, and South well field) were originally entered in the model as reservoirs. To accurately represent the water distribution system, these storage elements were changed to storage tanks option provided by the WaterCAD model. Tank parameters were calculated from the design drawings provided by the City of Elkhart. Tank information is presented in Table 2. For each of these tanks it was assumed that the base and minimum elevations are identical and that there is no inactive volume. Ground elevations were taken from the USGS map.

Table 2 – Tank Parameters

Tank Name	Benham	Bower St	Riverview	South WF
Downstream	J-208	J-128	J-89	J-229
Ground El	750	744	755	763
Maximum	899	893.83	895	892.83
Base / Min	865	864	865	863
Initial	896.67	889.44	880.9	890.3
D (ft)	50	53.5	75.3	53.5
Volume (MG)	0.5	0.5	1	0.5

- Hazen-Williams friction coefficients for pipes in the model were updated based upon GIS information service areas for years 1974, 1986, and 1999. These coefficients were assigned to the pipes falling within the each service area using GIS information. The value of friction coefficients for different age of pipes was assigned using information available in standard hydraulic textbooks. C-Value assigned for pipes with different age groups is documented in Table 3.
-

Table 3 – C-Values

Pipe Centroid Within	C-Value Assigned
1974 boundary	90
1986 boundary	100
1999 boundary	110
Outside 1999	120

CALIBRATION STEP 2: The 2nd step in model calibration was carried out by verification of the elevated storage tank height and ground elevation for all the four elevated storage tanks. This information verification with available information sources was important to match the model pressures with recorded pressures at the tanks. Table 4, contains the updated elevation and other parameters for the four tanks.

Table 4 – Calibrated Tank Parameters

Tank Name	Benham	Bower St	Riverview	South WF
Downstream	J-208	J-128	J-89	J-229
Ground El	739.54	739.00	752.70	756.10
Maximum	888.54	888.83	892.70	885.93
Base / Min	854.54	859.00	862.70	856.10
Initial	886.21	884.44	878.60	883.40
D (ft)	50	53.5	75.3	53.5
Volume (MG)	0.5	0.5	1	0.5

CALIBRATION STEP 3: The 3rd step in model calibration consisted of adjusting the Hazen-Williams C-values for pipes in the service area of the well fields. Factors were increased to reduce local pressures, and reduced to increase local pressures. Attached Table B contains information for the pipes where C-Values was adjusted for the model calibration.

CALIBRATION STEP 4: The 4th step in model calibration consisted of adjusting the assigned demands. The model node demand allocation was assigned by Geo-Coding customer billing data by a highly accurate technique. So due to this accurate technique, calibration steps 1 through 3 resulted in very good match between measured and predicted pressure, without any adjustment to demands or demand shifting to other nodes.

APPENDIX - I contain all the model-predicted data generated from the calibration run with fixed inflow at the well field discharge junctions in the WaterCAD model, as well as the data recorded on June 9th, 1999 for comparison.

Figure 1A, contains the overall demand for the model and the system demand (well field and tank flow).

Figures 1B through 1D contains the well field discharge pressures for the model predicted Vs recorded data.

Figures 1E through 1H contains the elevated tank pressures for the model predicted Vs recorded data.
Figures 1I through 1L contain the elevated tank in/out flows for the model predicted Vs recorded data.

CALIBRATION STEP 5: The final step in model calibration consisted of replacing the fixed inflow at well fields with dynamic pump on/off information in the model. The well field pump station information was incorporated in to the model. With the system substantially calibrated in step 4, the matching of the maximum day data for June 9, 1999, with connected well field pumps was expected to be relatively smooth process. The well field pump stations were connected to the water distribution system in the model. The model inflows at the well fields were removed with dynamic pump station information for the historical maximum day.

Pump curves in the model were checked against design curves supplied by the City of Elkhart. Tables 5A, 5B, and 5C contain the pump curve information used in the model based on the manufactured supplied pump curves provide by the City of Elkhart.

Table 5A – Pump Curve information for the Northwest well field

PMP-696 1.25 mgd		PMP-736 2.40 A		PMP-726 2.40 B		PMP-716 4.75 A		PMP-706 4.75 B	
Flow (mgd)	Head (ft)	Flow (mgd)	Head (ft)	Flow (mgd)	Head (ft)	Flow (mgd)	Head (ft)	Flow (mgd)	Head (ft)
0	200	0	264	0	264	0	276	0	276
1.25	165	2.4	170	2.4	170	4.75	183	4.75	183
2.2	50	3	110	3	110	6	135	6	135

Table 5B – Pump curve information for the South well field.

PMP-646 1.00 mgd		PMP-656 2.00 mgd		PMP-657 3.00 mgd	
Flow (mgd)	Head (ft)	Flow (mgd)	Head (ft)	Flow (mgd)	Head (ft)
0	260	0	245	0	236
1.02	170	1.9	170	*138*	*3*
1.3	106	2.45	97	91	3.74

Table 5C – Pump curve information for the North Main well field

PMP-676 2.25 mgd		PMP-106 3.50 mgd		PMP-686 4.25 mgd		PMP-006 5.25 mgd		PMP-666 6.00 mgd	
Flow (mgd)	Head (ft)	Flow (mgd)	Head (ft)	Flow (mgd)	Head (ft)	Flow (mgd)	Head (ft)	Flow (mgd)	Head (ft)
0	215	0	282	0	230	*0*	*220*	0	220
2.25	185	3.5	200	5.04	160	*5.25*	*150*	*6*	*200*
3.89	57	4.32	110	6.48	120	*7*	*100*	10.66	125

Even though friction factors in the system were sufficiently calibrated, there still were unresolved variables that well fields introduced to the water system model. A large number of valves exist on all the well field pump stations. Due to lack of information related to performance of these valves, these valves were not included in the model. In addition to valves, the performance of a pump in field often differs from the manufactured supplied pump curve information. In order to curb surging pressures in the system, due to valves, and inconsistent pump curves, the pressure reducing valves were added to the Northwest and North Main well fields.

Table 6, contains the information for the PRV's added to the system. Valve diameters are in inches and pressures are in psi. Valve locations were determined by examining the well field pipes for high pressures that correspond with nearby pumps being operational.

Table 6 – Pressure Relief Valves added at well fields

Valve	Field	Location	Diameter	Elevation	Pressure
PRV-1	North Main	Pipe 638	8	741	80
PRV-2	North Main	PMP-686	12	741	82
PRV-3	Northwest	PMP-736	14	780	50
PRV-4	Northwest	PMP-696	12	780	55

APPENDIX -II contain all the model-predicted data generated from the calibration run with dynamic pump station and PRV at the well field discharge in the WaterCAD model, as well as the data recorded on June 9th, 1999 for comparison.

Figure 2A, contains the overall demand for the model and the system demand (well field and tank flow).

Figures 2B through 2D contain the well field discharge pressures for the model predicted Vs recorded data.

Figures 2E through 2H contain the elevated tank pressures for the model predicted Vs recorded data.

Figures 2I through 2L contain the elevated tank in/out flows for the model predicted Vs recorded data.

CONCOLUSIONS

Calibration of the WaterCAD model has been completed for the historical maximum day demand of June 9, 1999. The model predicted Vs recorded flow and pressure data is matching very well. This calibrated model is good for making planning level decisions.

Further refinement in the calibration will require all or some combination of the following:

- The model is pressure calibrated at 3 known locations the elevated storage tanks. No flow or pressure data was available in system outskirts.
- Additional flow and pressure data will definitely improve model calibration.
- Pump curves used for model development and calibration were manufactured supplied pump curves. The field pump test of the well field pumps will further improve the model calibration/prediction.
- Verification that the following pipes in the system is closed as the existing model reports: 541, 514, 356, 357, 413, 412, and 188.

Attachments:
Figure 1 - Demand Patterns
TABLE A – Model Node Demand Distribution
TABLE B – C-Value Calibration
Appendix –I, The model-predicted Vs recorded plots for fixed inflow calibration run.
Appendix - II - The model-predicted Vs recorded plots for dynamic pump station run.

FIGURE 1

DEMAND PATTERNS

Figure 1 -- Demand Patterns

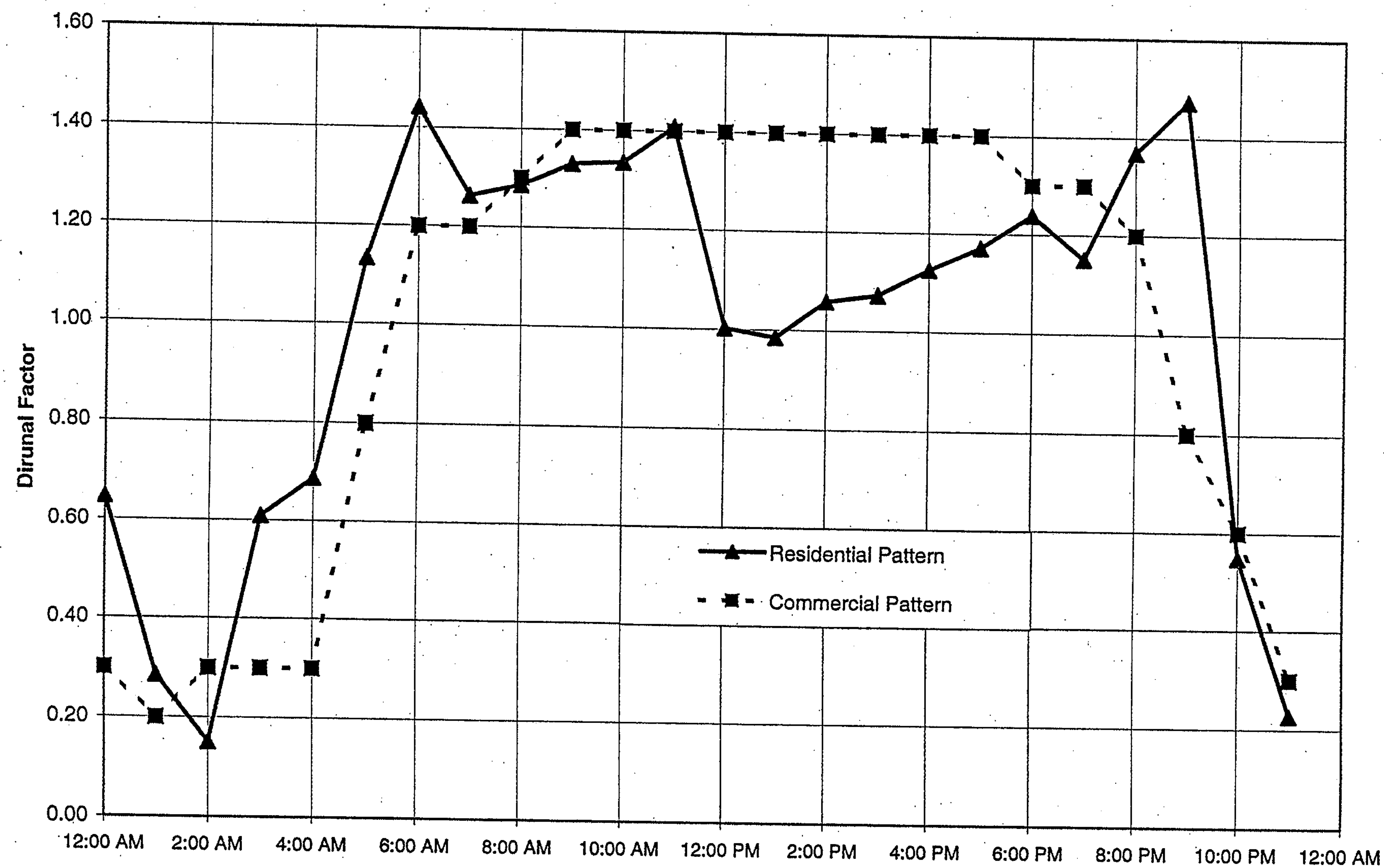


TABLE A

MODEL NODE DEMAND DISTRIBUTION

Model Node/ Polygon ID	Average Day Demand (gpd)		Total Average Day Demand (gpd)	Maximum Day Demand (gpd)		Total Maximum Day Demand (gpd)
	Residential	Commercial		Residential	Commercial	
264	24773		24773	38073		38073
265	24202		24202	37195		37195
266	4860		4860	7470		7470
267	24362		24362	37441		37441
268	12746		12746	19588		19588
269	16660		16660	25604		25604
270	612		612	941		941
271	55060		55060	84619		84619
272	12405		12405	19064		19064
273	14495		14495	22277		22277
274	15997		15997	24585		24585
275	7559		7559	11617		11617
276	7751		7751	11912		11912
278	17065		17065	26226		26226
279	3229	2981	6210	4963	4581	9544
280	10792		10792	16586		16586
281	76366		76366	117363		117363
282	5576		5576	8570		8570
283	41732		41732	64136		64136
284	13833		13833	21259		21259
285	32369		32369	49747		49747
290	6271		6271	9637		9637
291	6999		6999	10757		10757
292	17264		17264	26532		26532
293	15177		15177	23325		23325
294	10929		10929	16797		16797
295	9961		9961	15308		15308
296	1650		1650	2536		2536
297	319		319	491		491
299		2857	2857	0	4390	4390
300	17562		17562	26990		26990
302	14780		14780	22714		22714
304	962		962	1478		1478
308	18102		18102	27820		27820
309	795		795	1222		1222
310	1624		1624	2496		2496
314	15911		15911	24452		24452
315	8917		8917	13705		13705
316	7551		7551	11605		11605
317	11699		11699	17980		17980
318	7129		7129	10956		10956
320	5614		5614	8628		8628
321	21587		21587	33176		33176
325	24318		24318	37373		37373
326	6384		6384	9811		9811
329		4794	4794	0	7368	7368
331	108469		108469	166702		166702
332	10658		10658	16381		16381
334	7452		7452	11452		11452
344	88138	2708	90845	135455	4161	139616
346	12122		12122	18629		18629
348	2534		2534	3894		3894
349	820		820	1260		1260

Model Node/ Polygon ID	Average Day Demand (gpd)		Total Average Day Demand (gpd)	Maximum Day Demand (gpd)		Total Maximum Day Demand (gpd)
	Residential	Commercial		Residential	Commercial	
350	2683		2683	4123		4123
351	2029		2029	3118		3118
352	8048		8048	12369		12369
353	15829		15829	24327		24327
385	109990		109990	169039		169039
397		50	50	0	76	76
408	16589		16589	25494		25494
414	2333		2333	3585		3585
431	4223		4223	6490		6490
437	15987		15987	24570		24570
438	26		26	39		39
439	8416		8416	12935		12935
446	18269		18269	28077		28077
447	26159		26159	40203		40203
453	47223		47223	72575		72575
454	9116	16959	26075	14010	26063	40073
460	22480		22480	34548		34548
461	29460		29460	45275		45275
GIS UNMATCHED DEMAND						
1	18304		18304	28068		28068
2	18304		18304	28068		28068
3	18304		18304	28068		28068
4	18304		18304	28068		28068
5	18304		18304	28068		28068
6	18304		18304	28068		28068
11	18304		18304	28068		28068
12	18304		18304	28068		28068
14	18304		18304	28068		28068
19	18304		18304	28068		28068
25	18304		18304	28068		28068
28	18304		18304	28068		28068
32	18304		18304	28068		28068
35	18304		18304	28068		28068
36	18304		18304	28068		28068
37	18304		18304	28068		28068
39	18304		18304	28068		28068
40	18304		18304	28068		28068
41	18304		18304	28068		28068
51	18304		18304	28068		28068
52	18304		18304	28068		28068
62	18304		18304	28068		28068
63	18304		18304	28068		28068
64	18304		18304	28068		28068
66	18304		18304	28068		28068
67	18304		18304	28068		28068
68	18304		18304	28068		28068
69	18304		18304	28068		28068
70	18304		18304	28068		28068
78	18304		18304	28068		28068
79	18304		18304	28068		28068
80	18304		18304	28068		28068
81	18304		18304	28068		28068
132	18304		18304	28068		28068

Model Node/ Polygon ID	Average Day Demand (gpd)		Total Average Day Demand (gpd)	Maximum Day Demand (gpd)		Total Maximum Day Demand (gpd)
	Residential	Commercial		Residential	Commercial	
133	18304		18304	28068		28068
134	18304		18304	28068		28068
135	18304		18304	28068		28068
136	18304		18304	28068		28068
150	18304		18304	28068		28068
151	18304		18304	28068		28068
156	18304		18304	28068		28068
157	18304		18304	28068		28068
160	18304		18304	28068		28068
161	18304		18304	28068		28068
162	18304		18304	28068		28068
174	18304		18304	28068		28068
184	18304		18304	28068		28068
185	18304		18304	28068		28068
194	18304		18304	28068		28068
195	18304		18304	28068		28068
219	18304		18304	28068		28068
225	18304		18304	28068		28068
231	18304		18304	28068		28068
233	18304		18304	28068		28068
234	18304		18304	28068		28068
235	18304		18304	28068		28068
236	18304		18304	28068		28068
277	18304		18304	28068		28068
278	18304		18304	28068		28068
279	18304		18304	28068		28068
286	18304		18304	28068		28068
298	18304		18304	28068		28068
299	18304		18304	28068		28068
300	18304		18304	28068		28068
301	18304		18304	28068		28068
302	18304		18304	28068		28068
303	18304		18304	28068		28068
304	18304		18304	28068		28068
305	18304		18304	28068		28068
306	18304		18304	28068		28068
307	18304		18304	28068		28068
314	18304		18304	28068		28068
315	18304		18304	28068		28068
317	18304		18304	28068		28068
318	18304		18304	28068		28068
319	18304		18304	28068		28068
320	18304		18304	28068		28068
322	18304		18304	28068		28068
323	18304		18304	28068		28068
325	18304		18304	28068		28068
326	18304		18304	28068		28068
327	18304		18304	28068		28068
328	18304		18304	28068		28068
329	18304		18304	28068		28068
330	18304		18304	28068		28068
331	18304		18304	28068		28068
333	18304		18304	28068		28068

Model Node/ Polygon ID	Average Day Demand (gpd)		Total Average Day Demand (gpd)	Maximum Day Demand (gpd)		Total Maximum Day Demand (gpd)
	Residential	Commercial		Residential	Commercial	
334	18304		18304	28068		28068
335	18304		18304	28068		28068
336	18304		18304	28068		28068
337	18304		18304	28068		28068
338	18304		18304	28068		28068
340	18304		18304	28068		28068
341	18304		18304	28068		28068
342	18304		18304	28068		28068
343	18304		18304	28068		28068
346	18304		18304	28068		28068
347	18304		18304	28068		28068
348	18304		18304	28068		28068
349	18304		18304	28068		28068
350	18304		18304	28068		28068
351	18304		18304	28068		28068
352	18304		18304	28068		28068
353	18304		18304	28068		28068
365	18304		18304	28068		28068
382	18304		18304	28068		28068
383	18304		18304	28068		28068
384	18304		18304	28068		28068
385	18304		18304	28068		28068
386	18304		18304	28068		28068
387	18304		18304	28068		28068
388	18304		18304	28068		28068
389	18304		18304	28068		28068
390	18304		18304	28068		28068
391	18304		18304	28068		28068
392	18304		18304	28068		28068
393	18304		18304	28068		28068
394	18304		18304	28068		28068
395	18304		18304	28068		28068
396	18304		18304	28068		28068
397	18304		18304	28068		28068
398	18304		18304	28068		28068
399	18304		18304	28068		28068
400	18304		18304	28068		28068
401	18304		18304	28068		28068
402	18304		18304	28068		28068
403	18304		18304	28068		28068
404	18304		18304	28068		28068
405	18304		18304	28068		28068
406	18304		18304	28068		28068
407	18304		18304	28068		28068
409	18304		18304	28068		28068
410	18304		18304	28068		28068
411	18304		18304	28068		28068
412	18304		18304	28068		28068
413	18304		18304	28068		28068
414	18304		18304	28068		28068
415	18304		18304	28068		28068
416	18304		18304	28068		28068
417	18304		18304	28068		28068

Model Node/ Polygon ID	Average Day Demand (gpd)		Total Average Day Demand (gpd)	Maximum Day Demand (gpd)		Total Maximum Day Demand (gpd)
	Residential	Commercial		Residential	Commercial	
418	18304		18304	28068		28068
419	18304		18304	28068		28068
421	18304		18304	28068		28068
422	18304		18304	28068		28068
423	18304		18304	28068		28068
424	18304		18304	28068		28068
426	18304		18304	28068		28068
427	18304		18304	28068		28068
429	18304		18304	28068		28068
430	18304		18304	28068		28068
431	18304		18304	28068		28068
432	18304		18304	28068		28068
433	18304		18304	28068		28068
434	18304		18304	28068		28068
435	18304		18304	28068		28068
436	18304		18304	28068		28068
437	18304		18304	28068		28068
438	18304		18304	28068		28068
440	18304		18304	28068		28068
442	18304		18304	28068		28068
443	18304		18304	28068		28068
444	18304		18304	28068		28068
446	18304		18304	28068		28068
448	18304		18304	28068		28068
449	18304		18304	28068		28068
450	18304		18304	28068		28068
451	18304		18304	28068		28068
452	18304		18304	28068		28068
453	18304		18304	28068		28068
454	18304		18304	28068		28068
456	18304		18304	28068		28068
457	18304		18304	28068		28068
458	18304		18304	28068		28068
459	18304		18304	28068		28068
462	18304		18304	28068		28068
491	18304		18304	28068		28068
Total (gpd)	10,659,134	58,161	10,717,295	16,370,616	89,385	16,460,001
Total (mgd)	10.66	0.06	10.72	16.37	0.09	16.46

TABLE B

C-VALUE CALIBRATION

TABLE B
C-Value Calibration

Model Pipe ID	Estimated C-Value	Calibrated C-Value
16	90	100
22	90	100
23	90	100
24	90	100
25	90	100
26	90	100
27	90	100
28	90	100
29	90	100
30	90	100
31	90	100
32	90	100
47	100	110
127	90	100
128	90	100
129	90	100
130	90	100
131	90	100
132	90	100
133	90	100
137	90	100
138	90	100
139	90	100
140	90	100
143	90	100
144	90	100
145	90	100
146	90	100
147	90	100
179	90	80
180	90	80
186	90	80
189	100	90
190	100	90
191	100	90
192	90	80
193	90	80
195	90	80
196	90	80
197	90	80
198	90	80
199	90	80

Model Pipe ID	Estimated C-Value	Calibrated C-Value
200	90	80
201	90	80
203	90	80
204	90	80
205	90	80
206	100	90
207	90	80
208	90	80
210	90	80
211	100	90
212	90	80
213	90	80
214	90	80
215	90	80
216	100	90
217	90	80
218	90	80
219	90	80
220	90	80
221	90	80
229	90	80
247	90	100
249	100	110
251	90	100
253	90	80
254	90	100
255	90	100
256	90	100
266	90	80
271	90	100
273	90	100
286	90	100
288	90	100
291	90	100
300	90	80
301	90	100
302	90	100
303	90	100
304	90	100
305	90	100
309	90	100
310	90	100

Model Pipe ID	Estimated C-Value	Calibrated C-Value
312	90	100
313	90	100
315	90	100
321	90	80
322	90	80
323	90	100
337	90	80
338	90	80
339	90	100
345	100	110
347	90	100
348	90	100
349	90	100
350	90	100
351	90	100
353	110	120
354	90	100
355	90	100
356	90	110
359	90	100
360	90	100
402	90	100
454	110	120
455	110	120
456	110	120
457	110	120
458	110	120
464	110	120
466	110	120
467	110	120
468	110	120
469	110	120
470	110	120
471	110	120
472	110	120
473	110	120
474	110	120
475	110	120
476	110	120
553	110	120
554	110	120
583	90	80

APPENDIX - I

THE MODEL-PREDICTED VS RECORDED PLOTS FOR FIXED INFLOW CALIBRATION RUN

Figure 1A: Fixed Inflow at Well Fileds
Total System Demand Curve

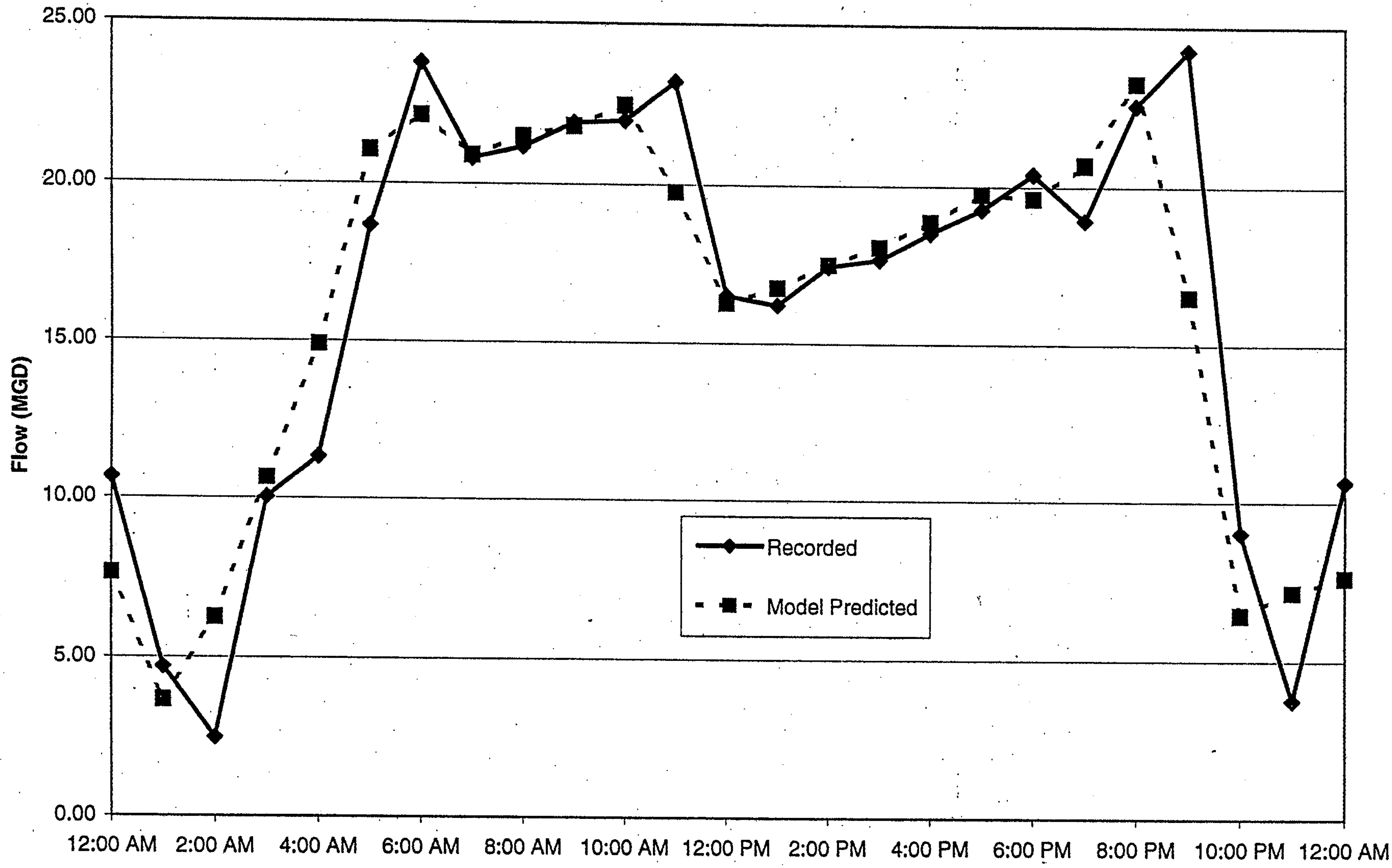


Figure 1B: Fixed Inflow at Well Fileds
North Well Field High Lift Discharge Pressure

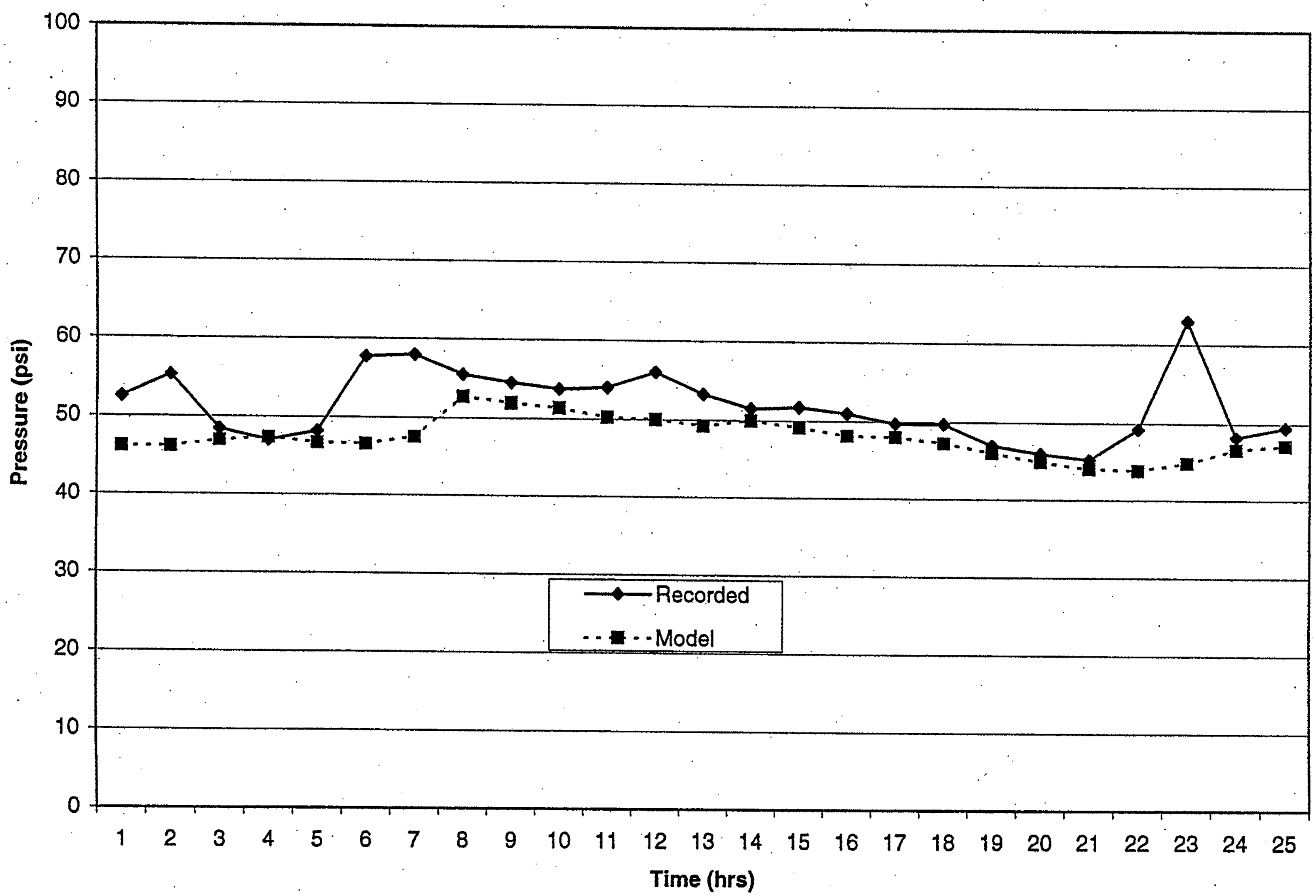


Figure 1C: Fixed Inflow at Well Fileds
South Well Field High Lift Discharge Pressure

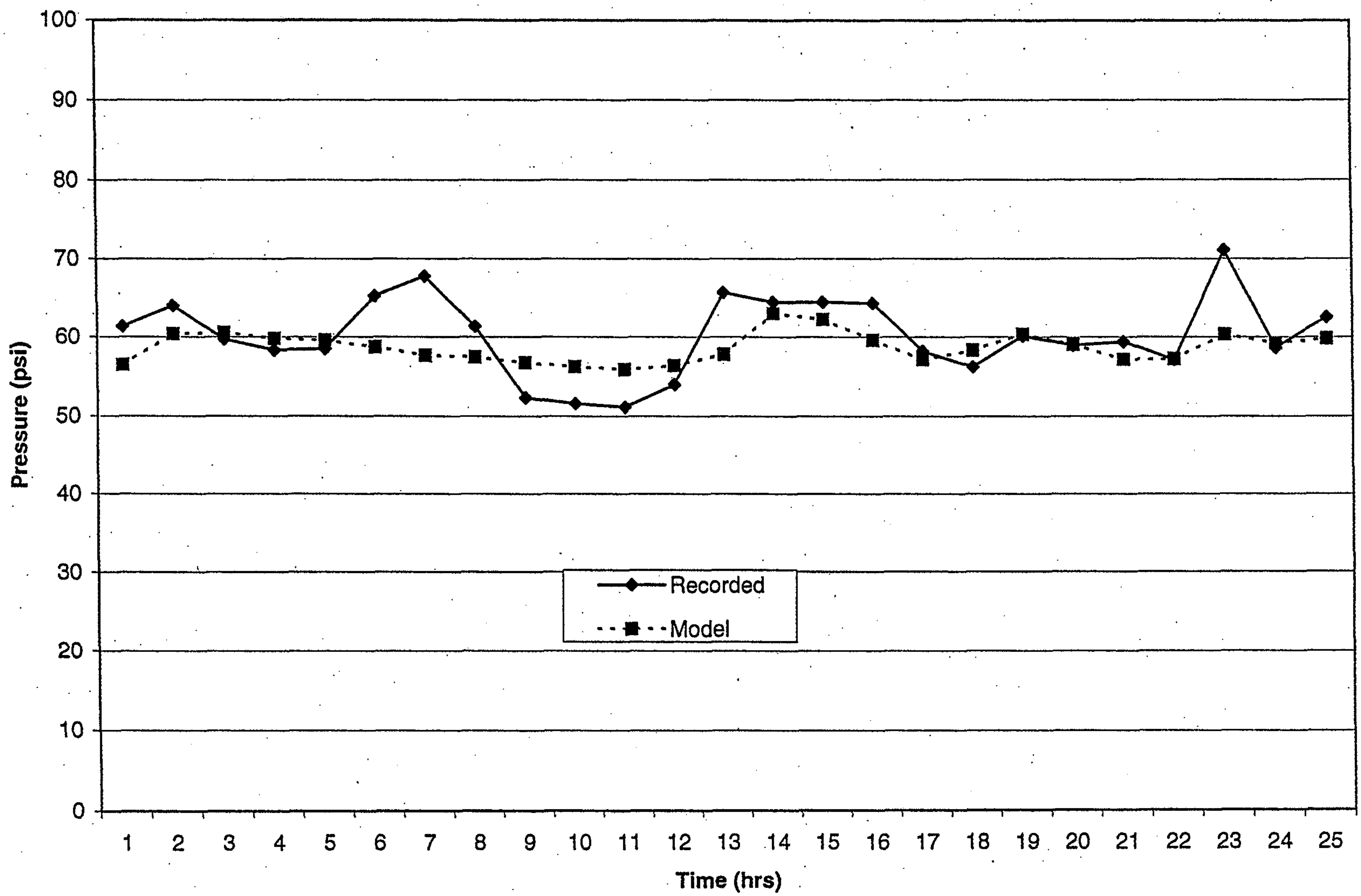


Figure 1D: Fixed Inflow at Well Fileds
North Main Well Field High Lift Discharge Pressure

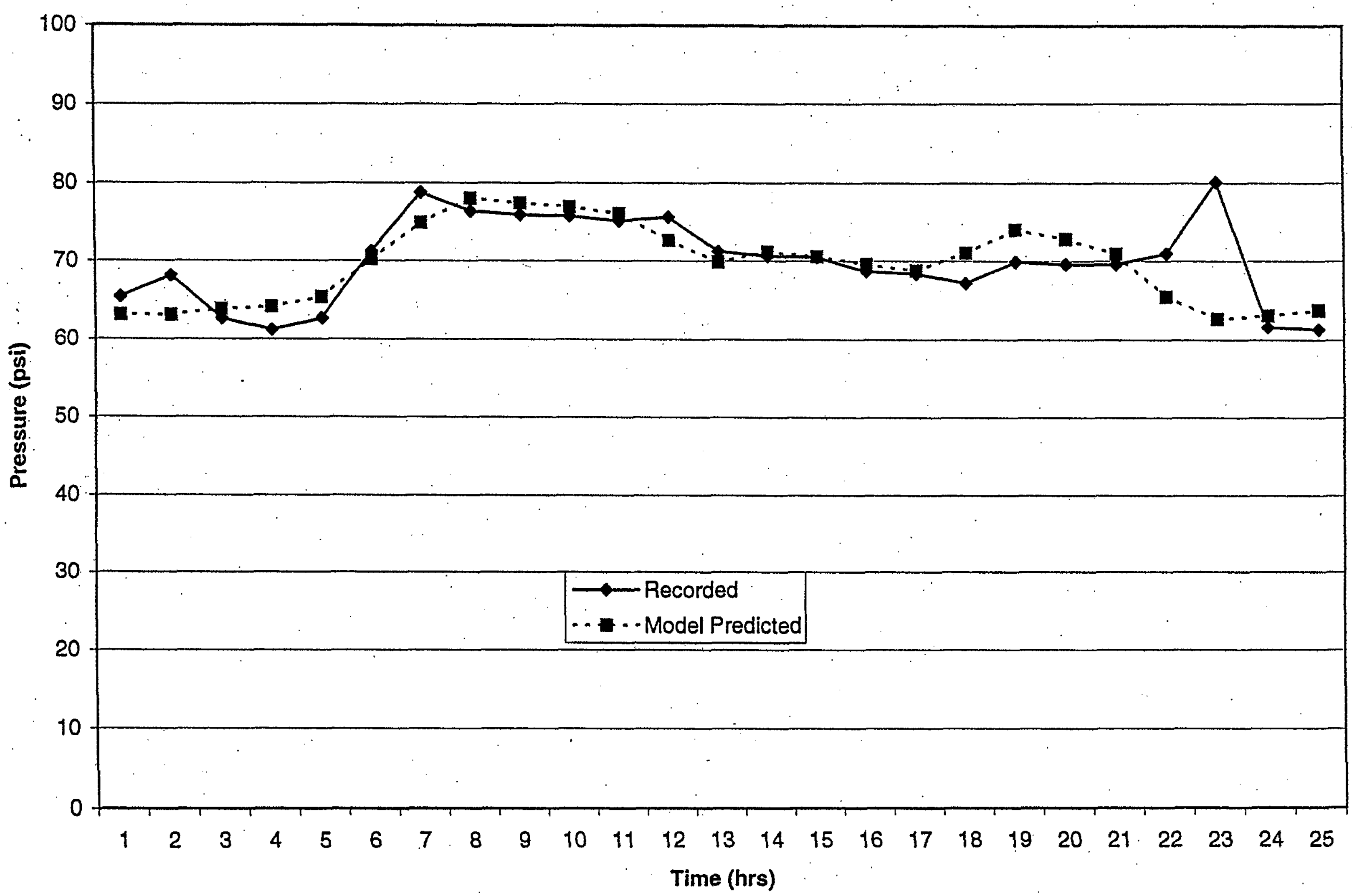


Figure 1E: Fixed Inflow at Well Fileds
Benham Tank Recorded Vs Predicted Pressure

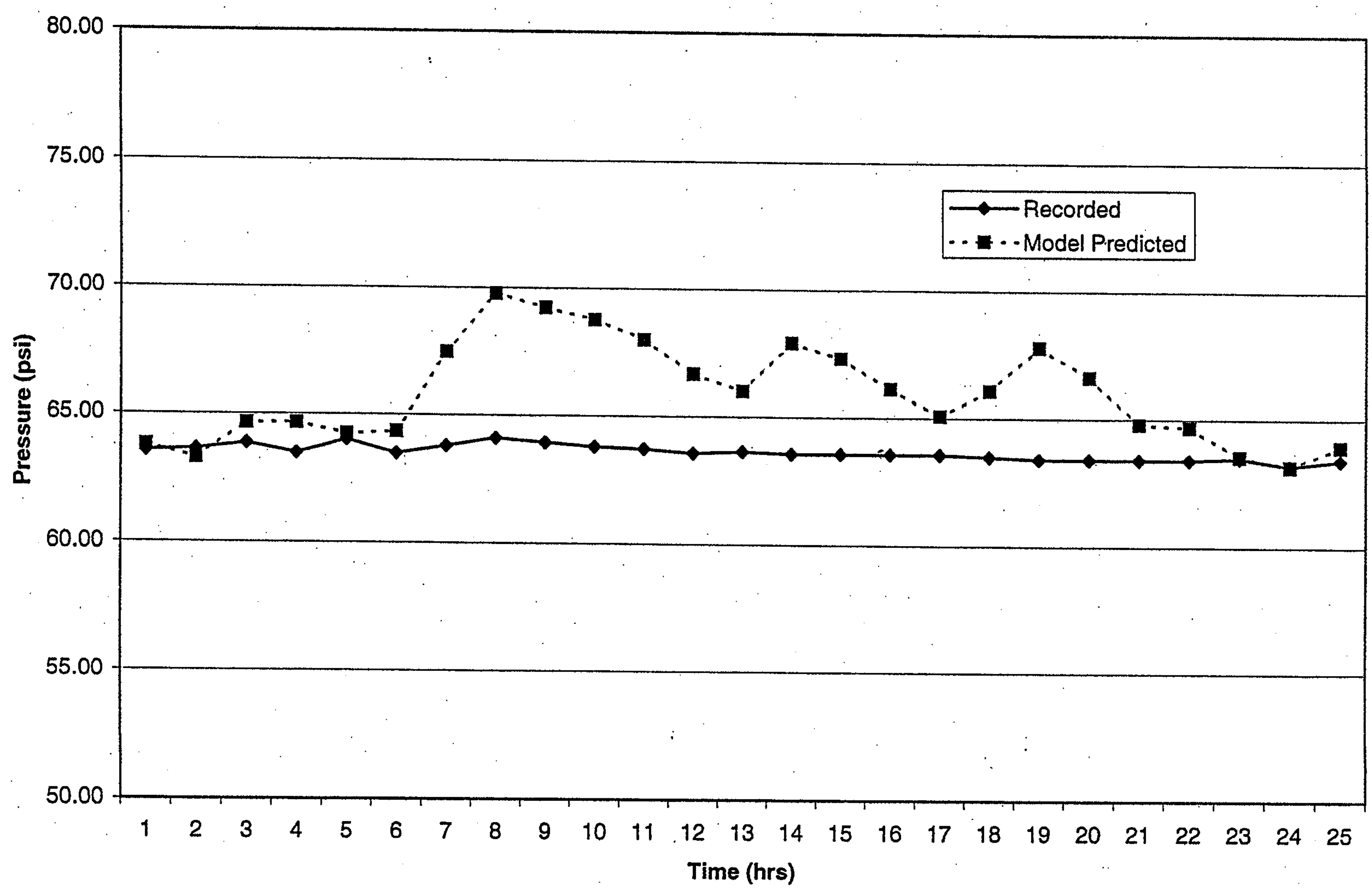


Figure 1F: Fixed Inflow at Well Fileds
Bower Tank Recorded Vs Predicted Pressure

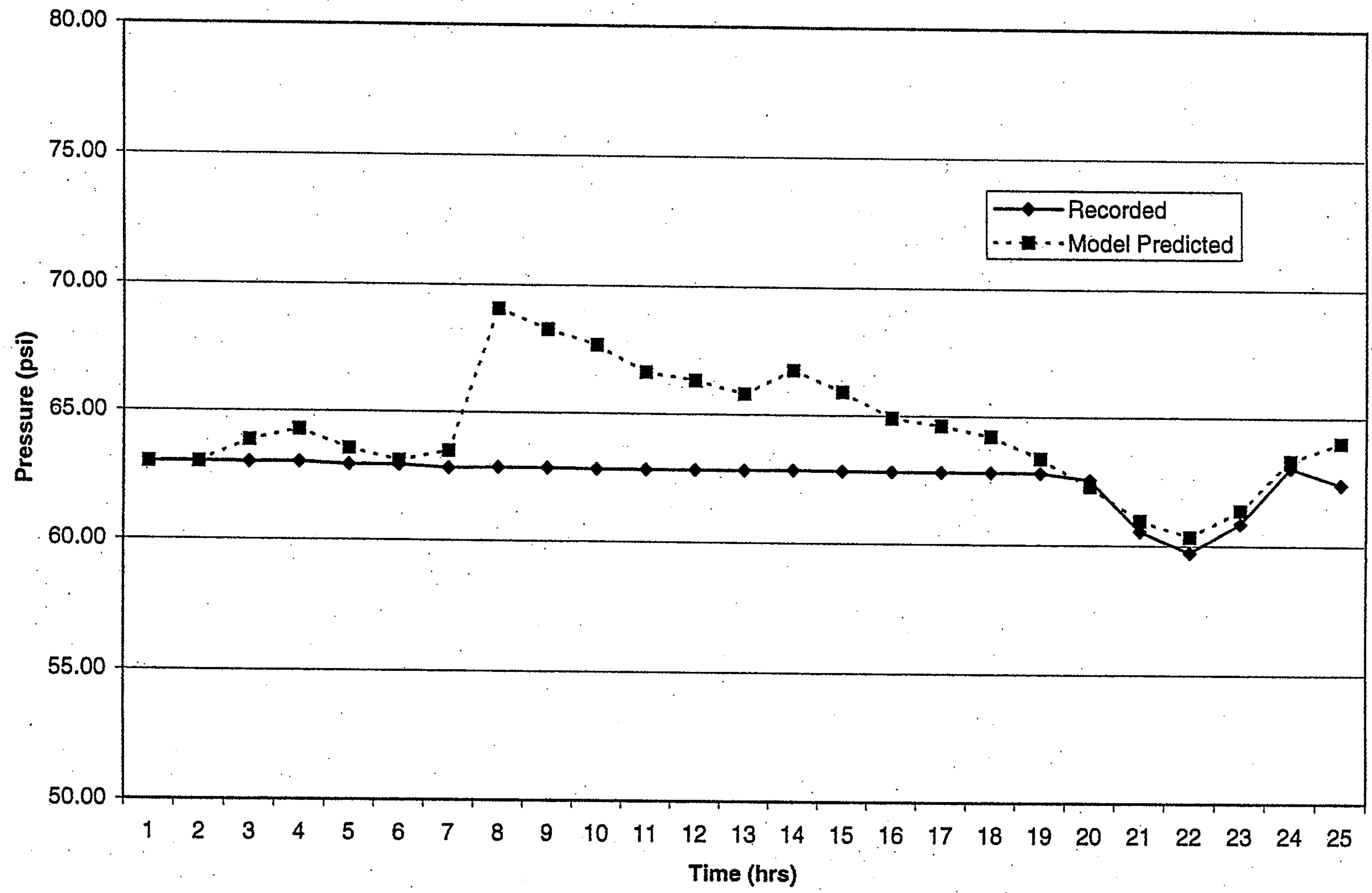


**Figure 1G: Fixed Inflow at Well Fileds
River View Tank Recorded Vs Predicted Pressure**

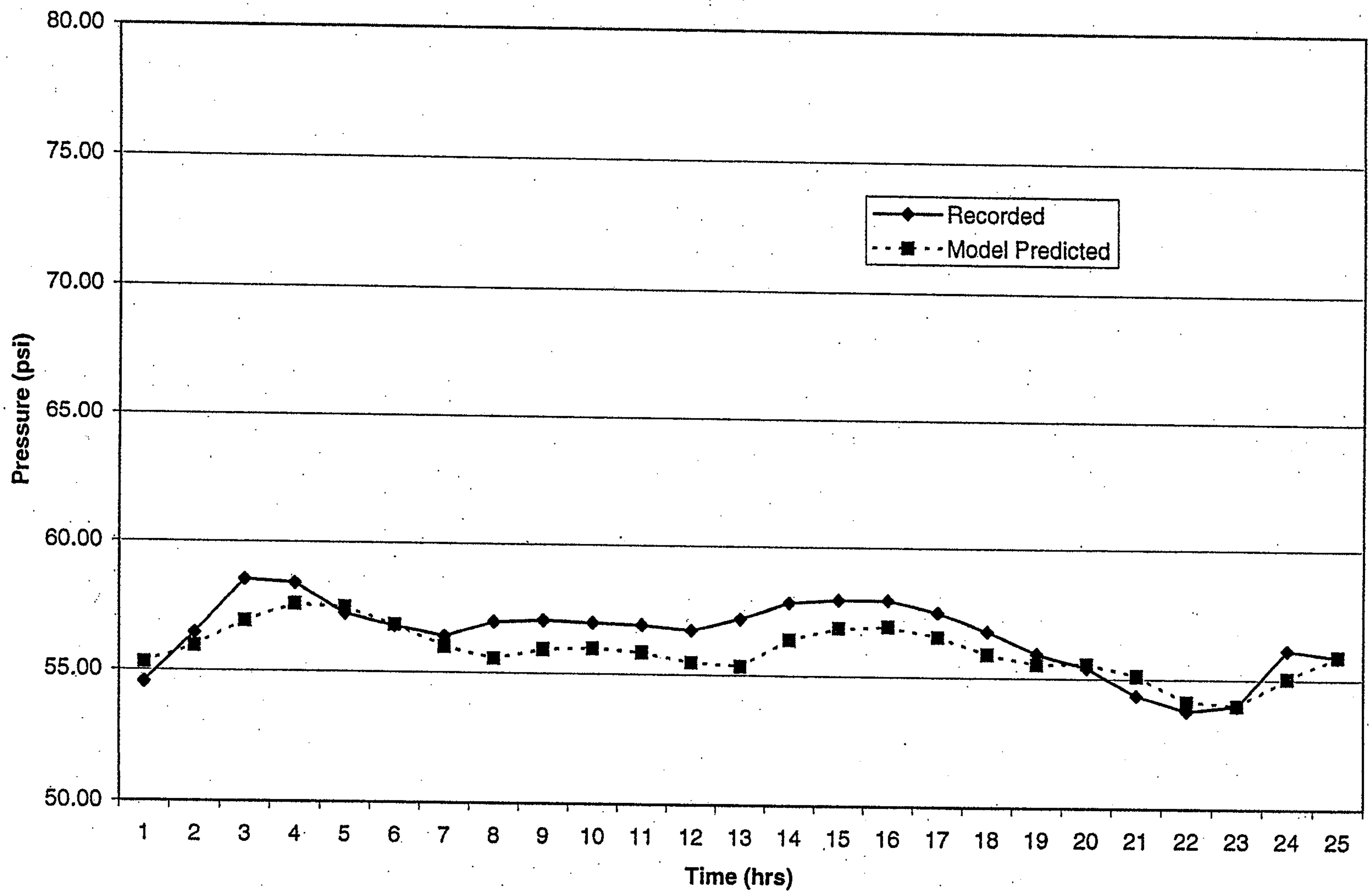


Figure 1H: Fixed Inflow at Well Fileds
South Tank Recorded Vs Predicted Pressure

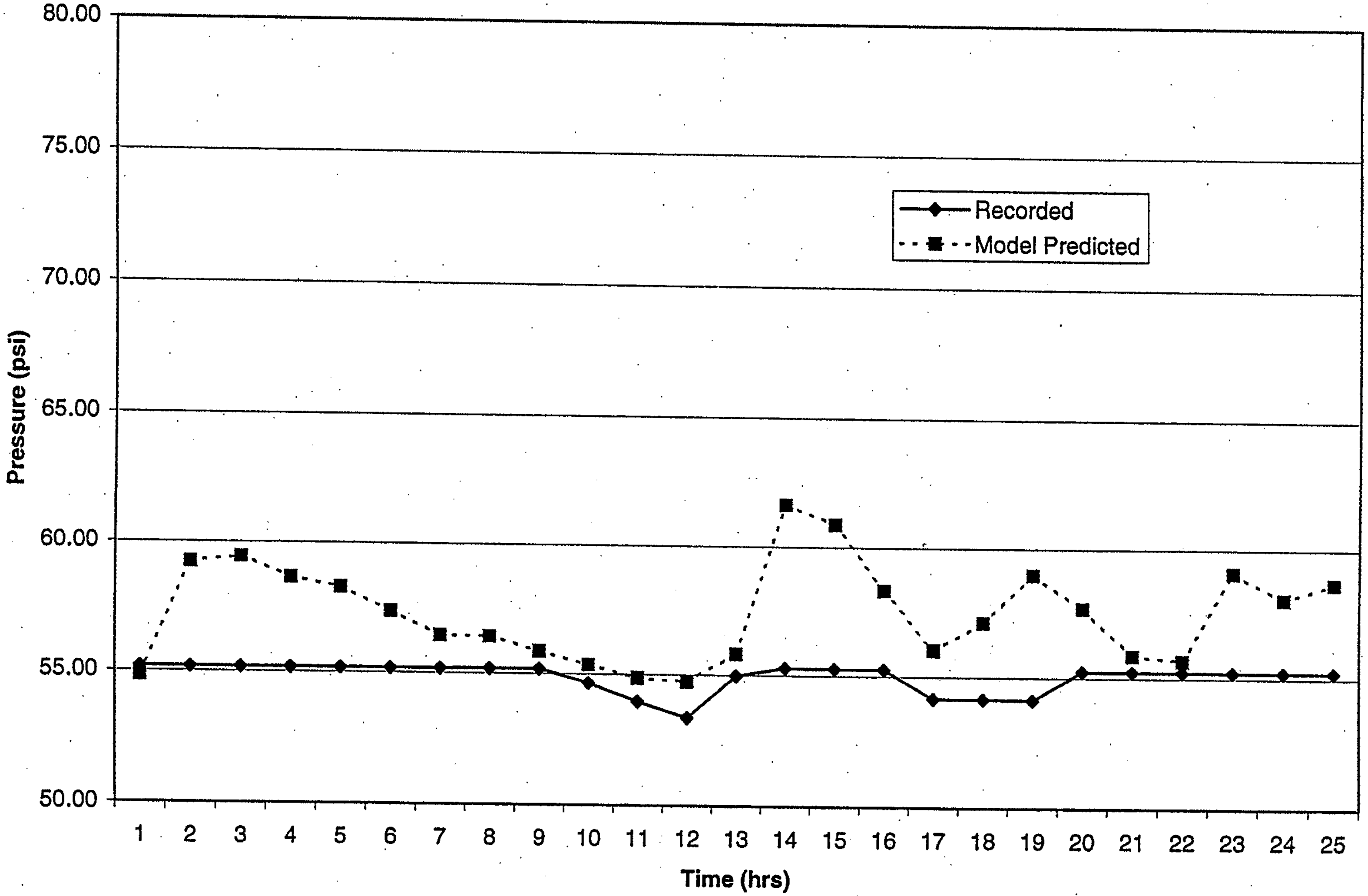


Figure 1l: Fixed Inflow at Well Fileds
Benham Tank Recorded Vs Predicted In/Out Flow

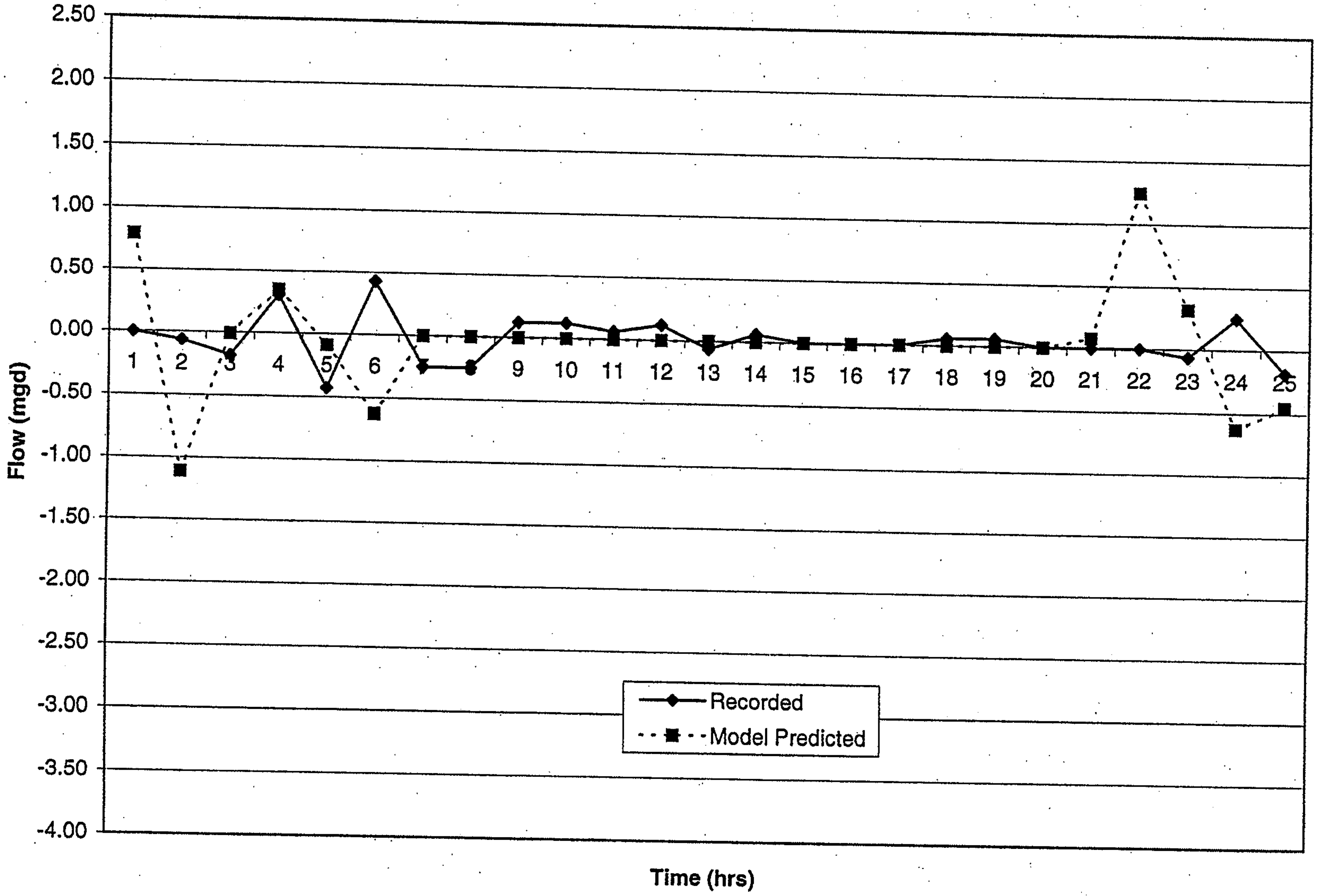


Figure 1J: Fixed Inflow at Well Fileds
Bower Tank Recorded Vs Predicted In/Out Flow

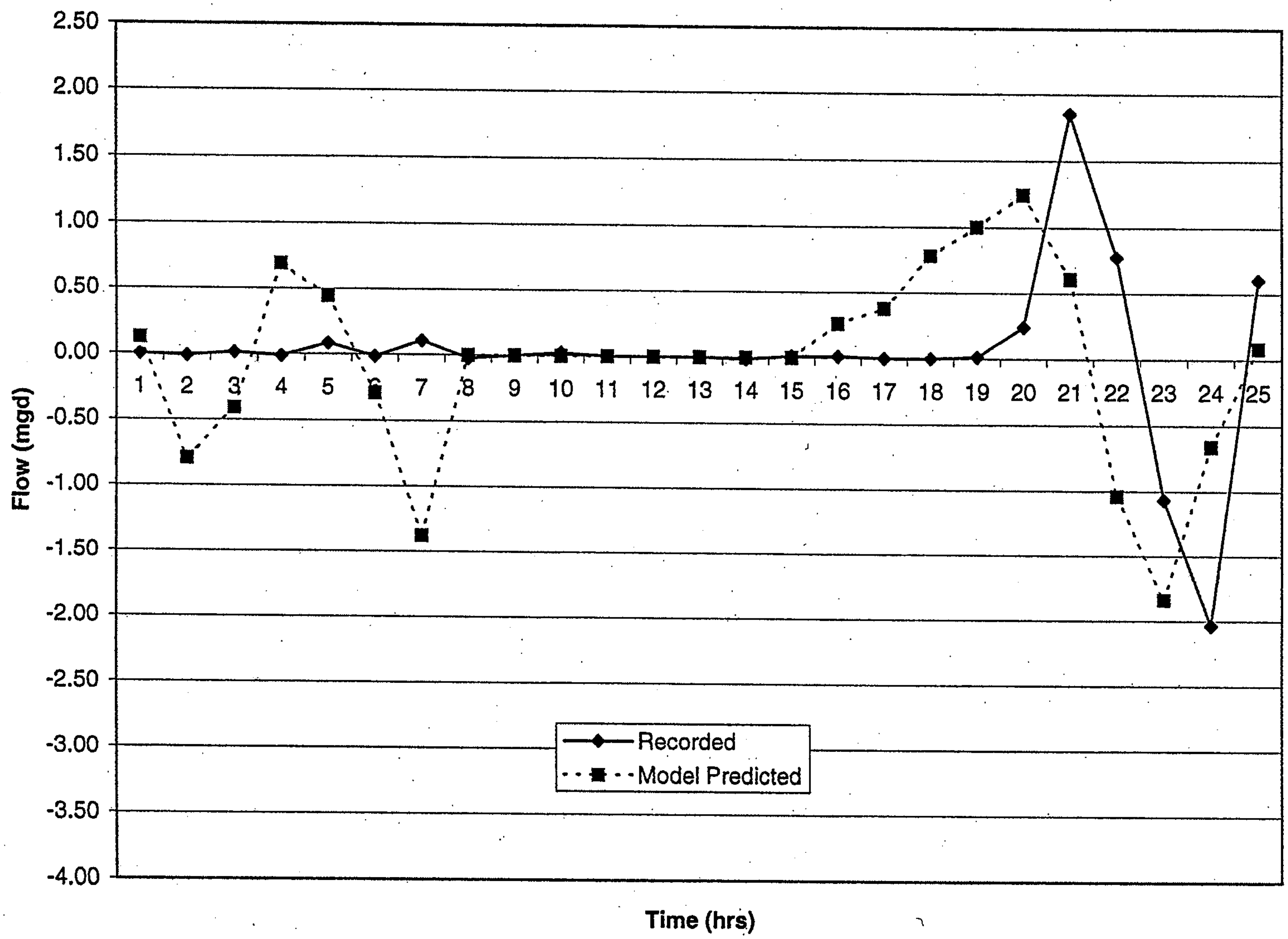


Figure 1K: Fixed Inflow at Well Fileds
RiverView Tank Recorded Vs Predicted In/Out Flow

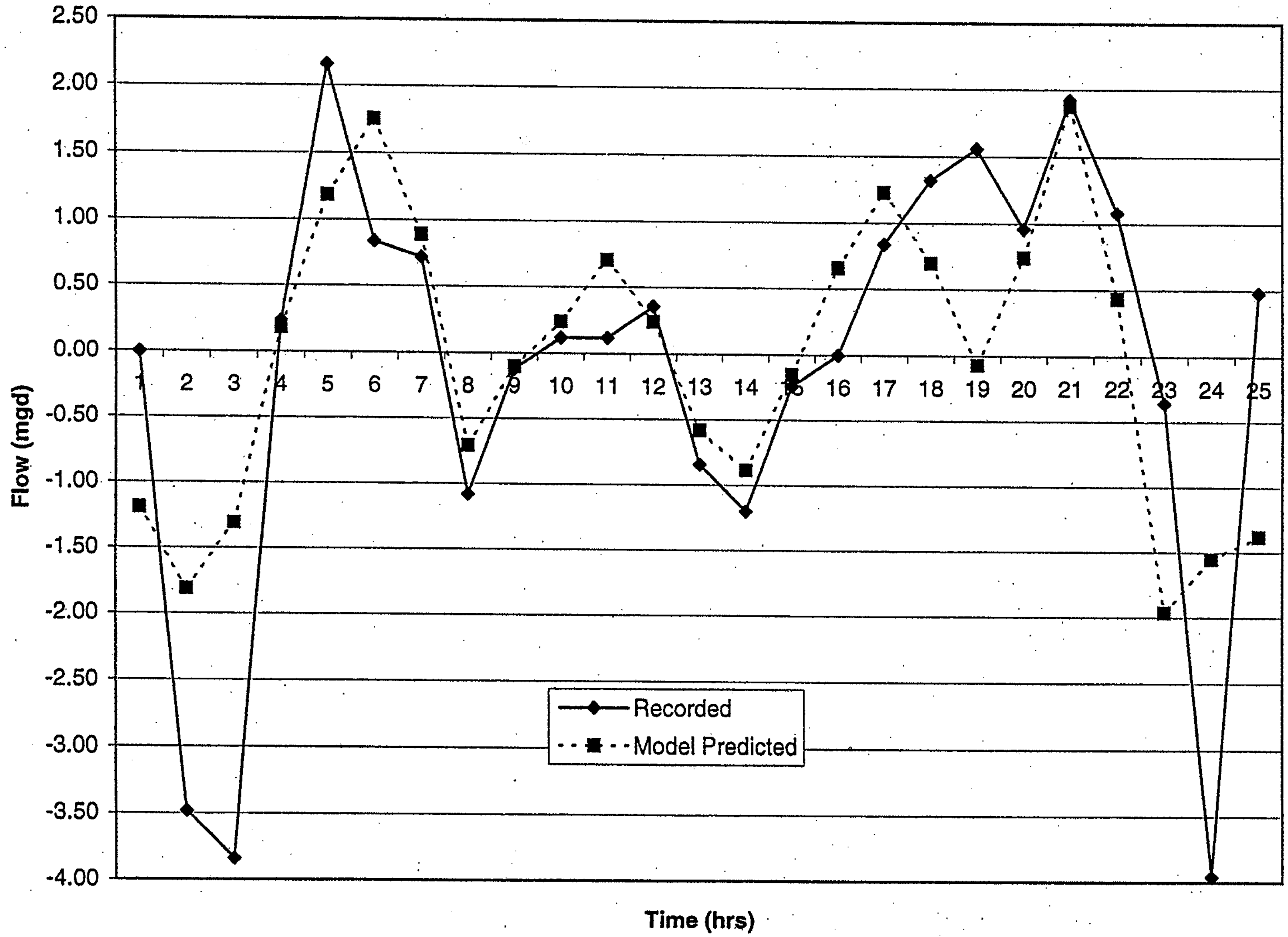
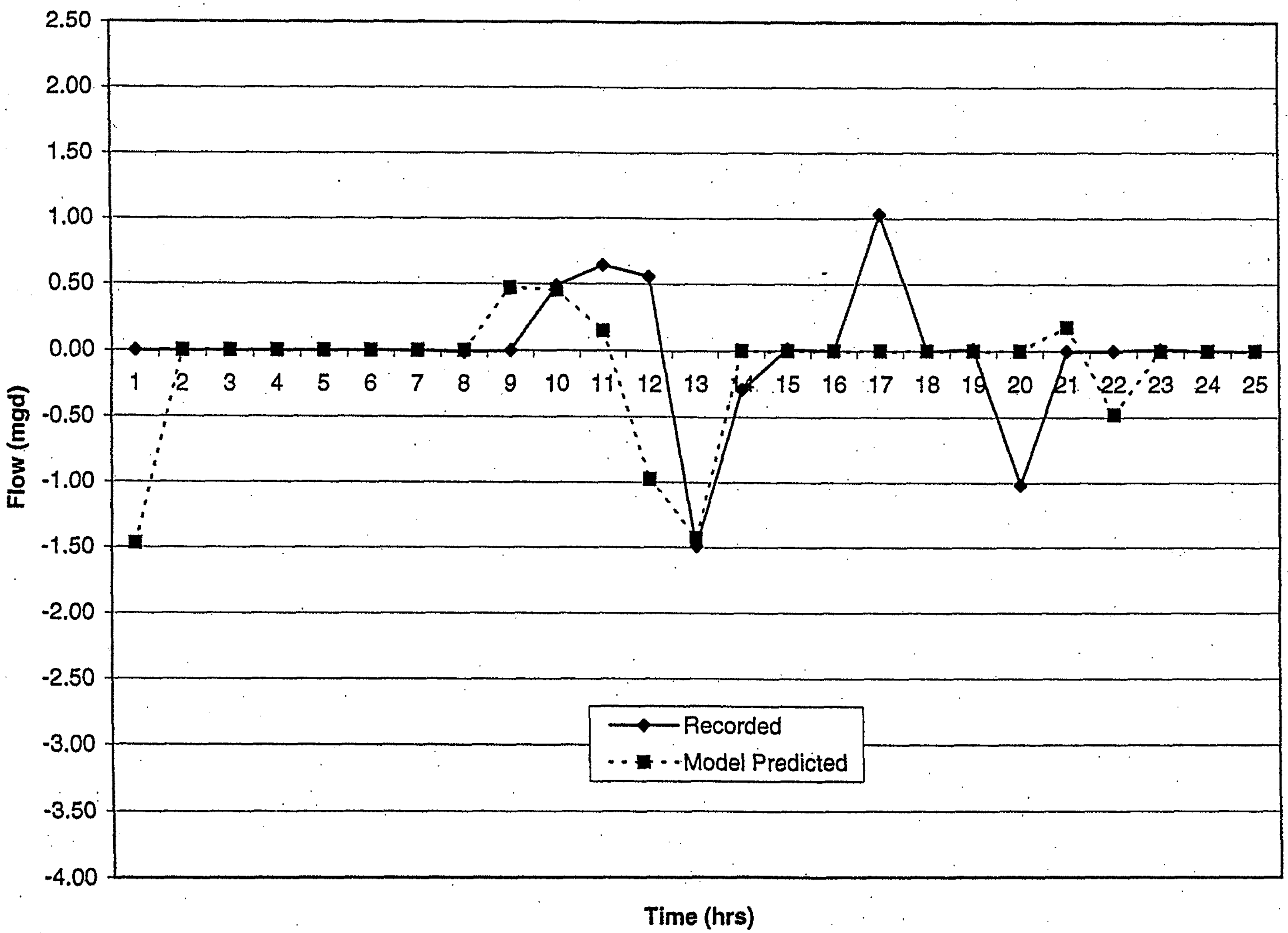


Figure 1L: Fixed Inflow at Well Fileds
South Tank Recorded Vs Predicted In/Out Flow



APPENDIX - II

THE MODEL-PREDICTED VS RECORDED PLOTS FOR DYNAMIC PUMP STATION CALIBRATION RUN

Figure 2A: Dynamic Pump Station
Total System Demand Curve

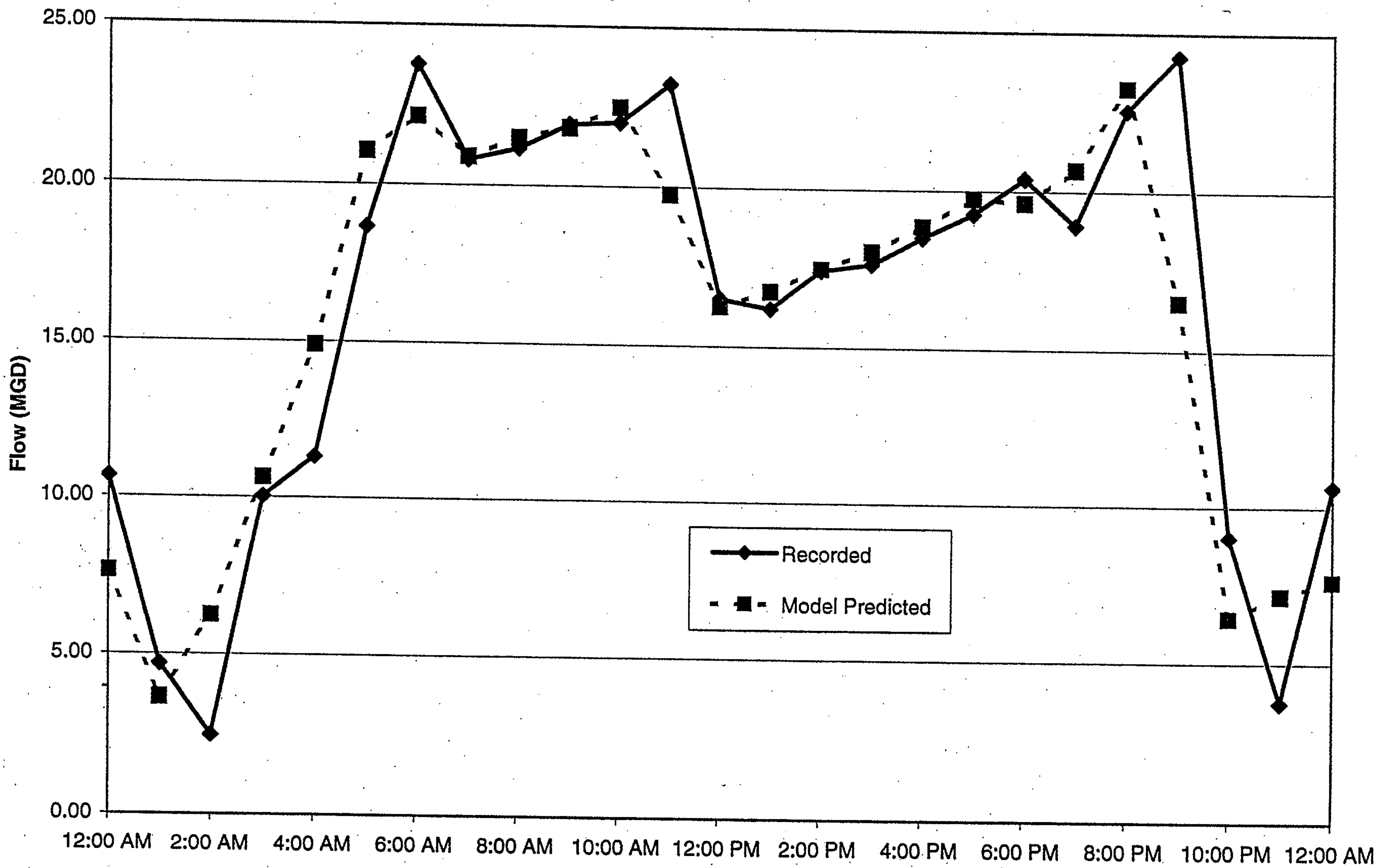


Figure 2B: Dynamic Pump Station
North Well Field High Lift Station Discharge Pressure

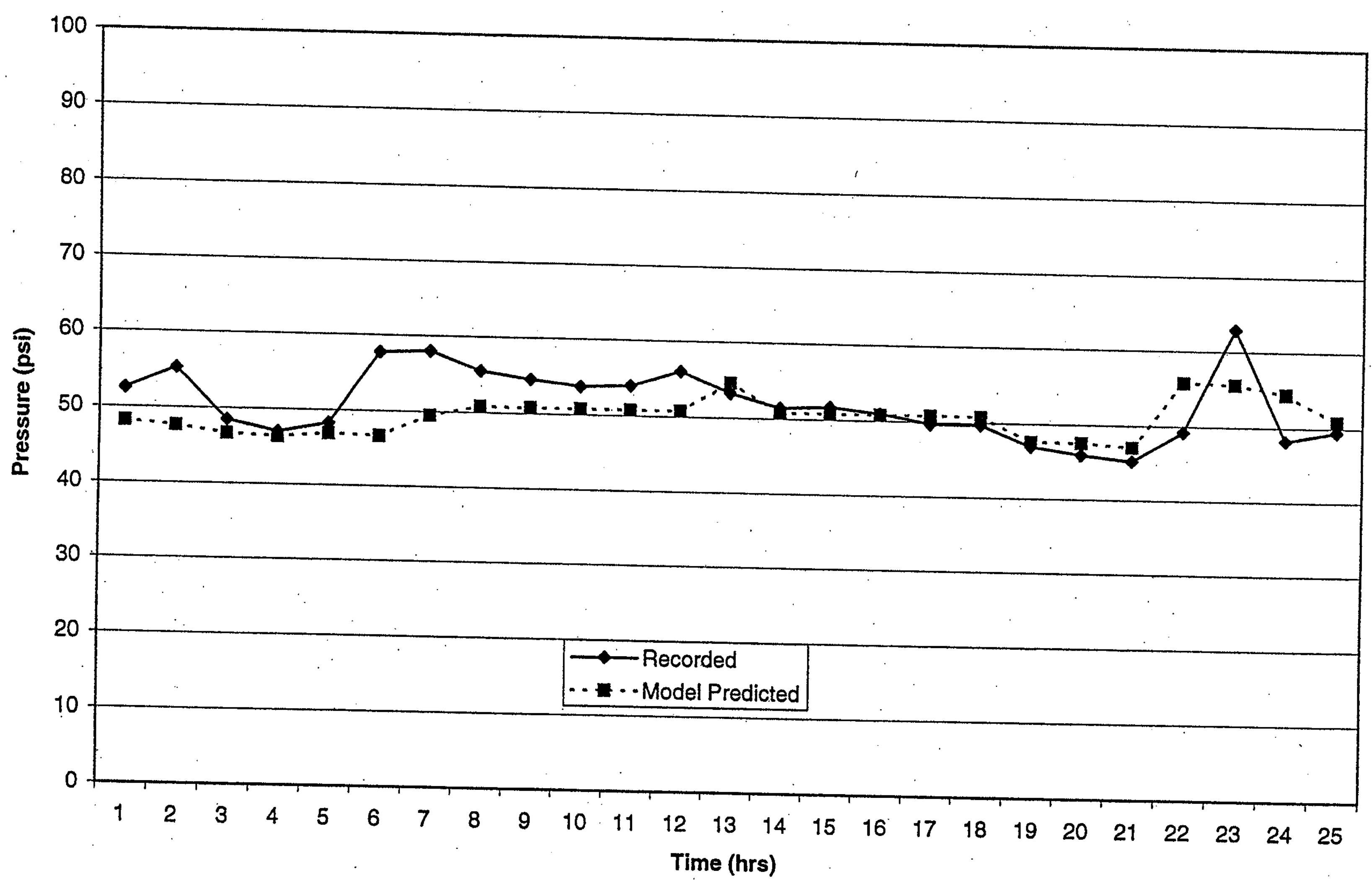


Figure 2C: Dynamic Pump Station
South Well Field High Lift Station Discharge Pressure

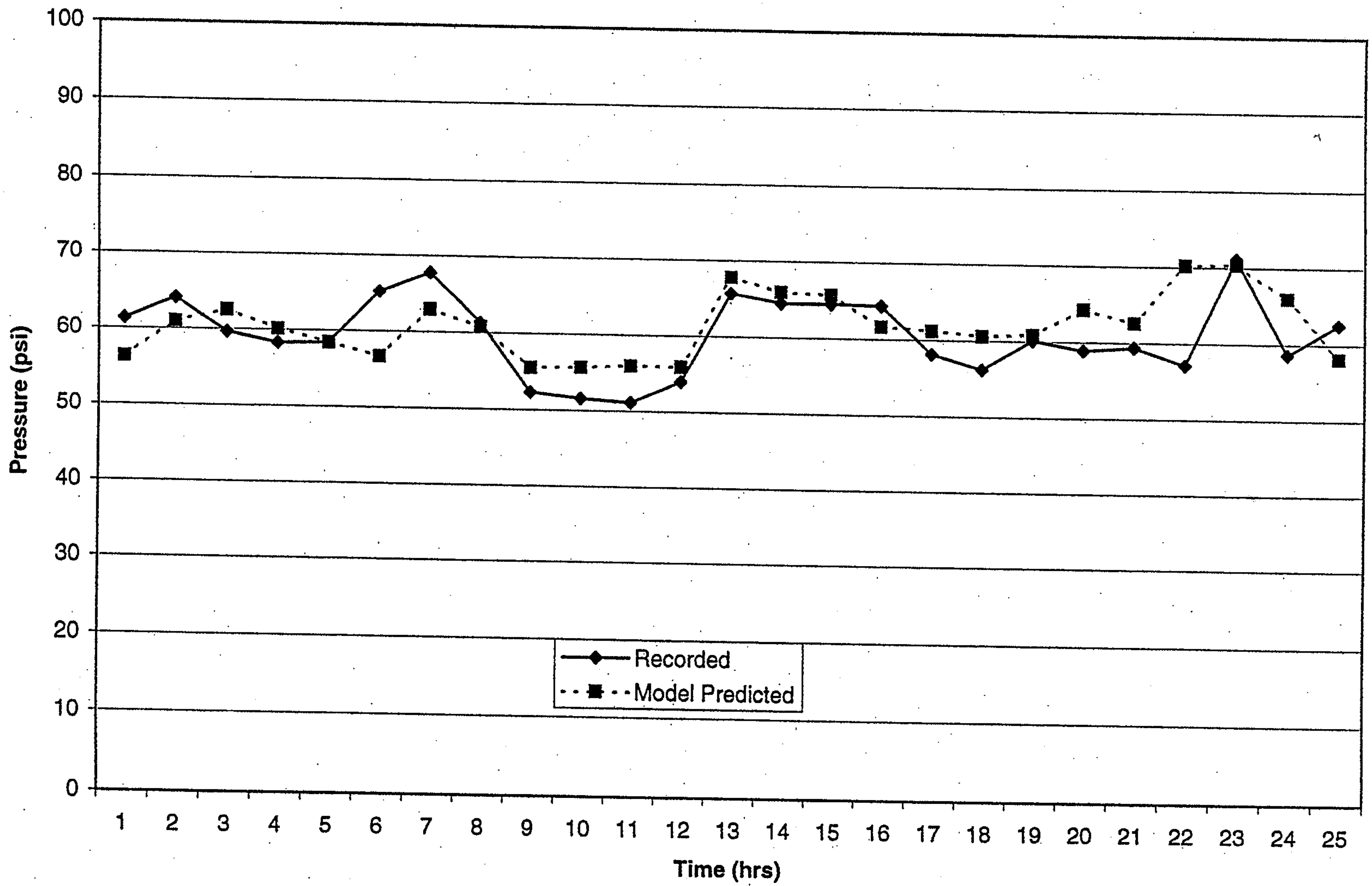


Figure 2D: Dynamic Pump Station
North Main Field High Lift Station Discharge Pressure

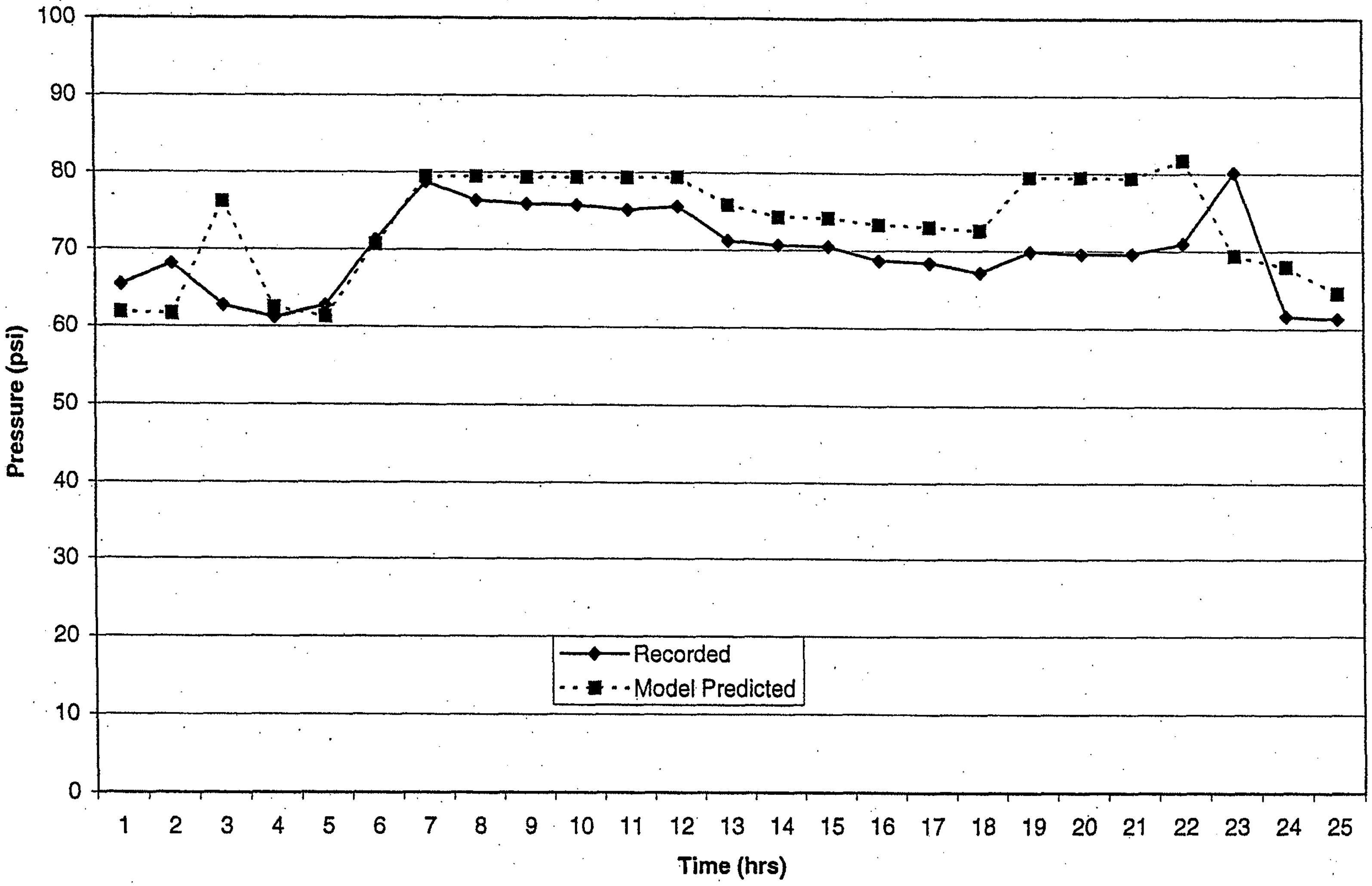


Figure 2E: Dynamic Pump Station
Benham Tank Recorded Vs Predicted Pressure

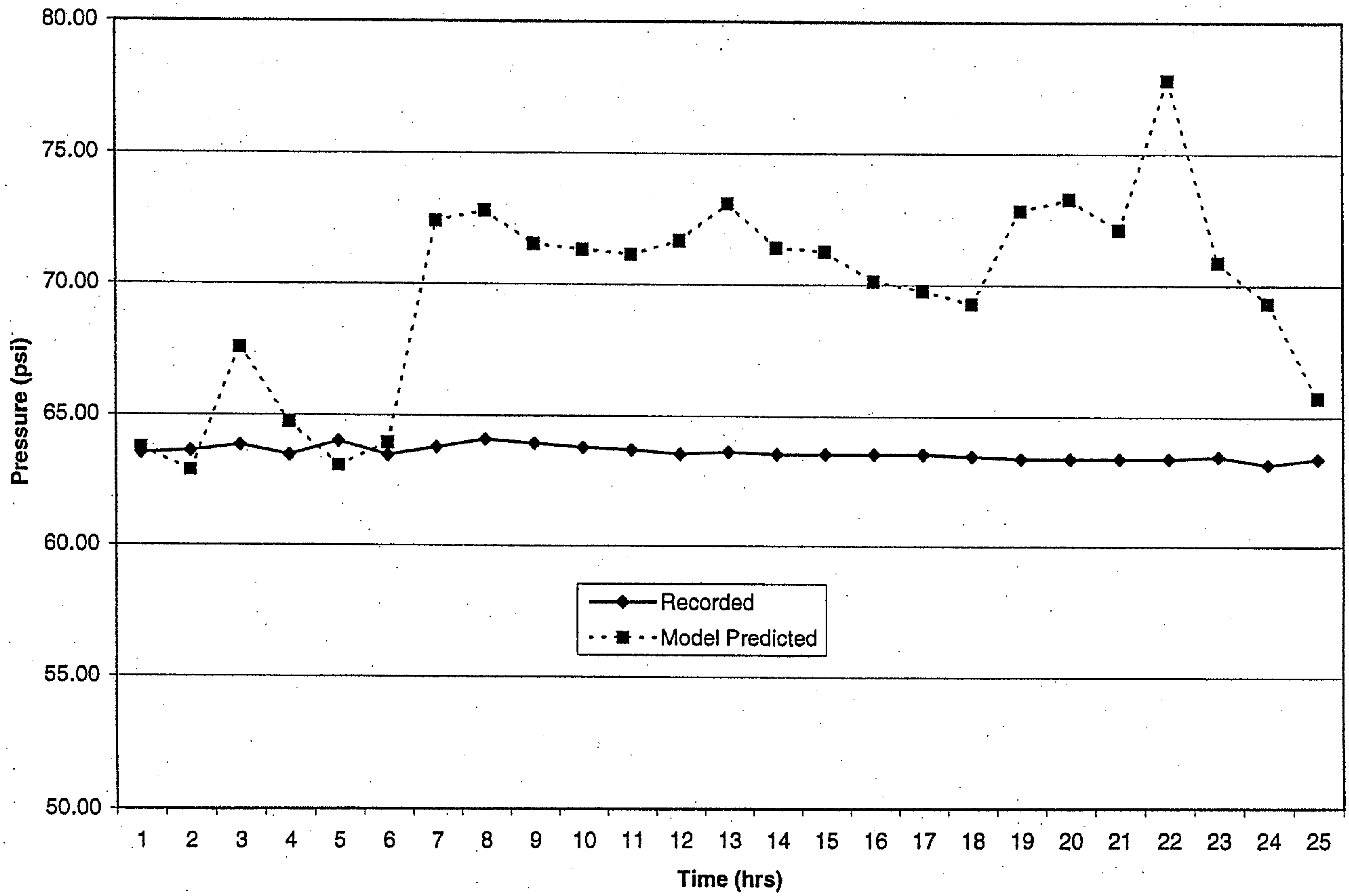


Figure 2F: Dynamic Pump Station
Bower Tank Recorded Vs Predicted Pressure

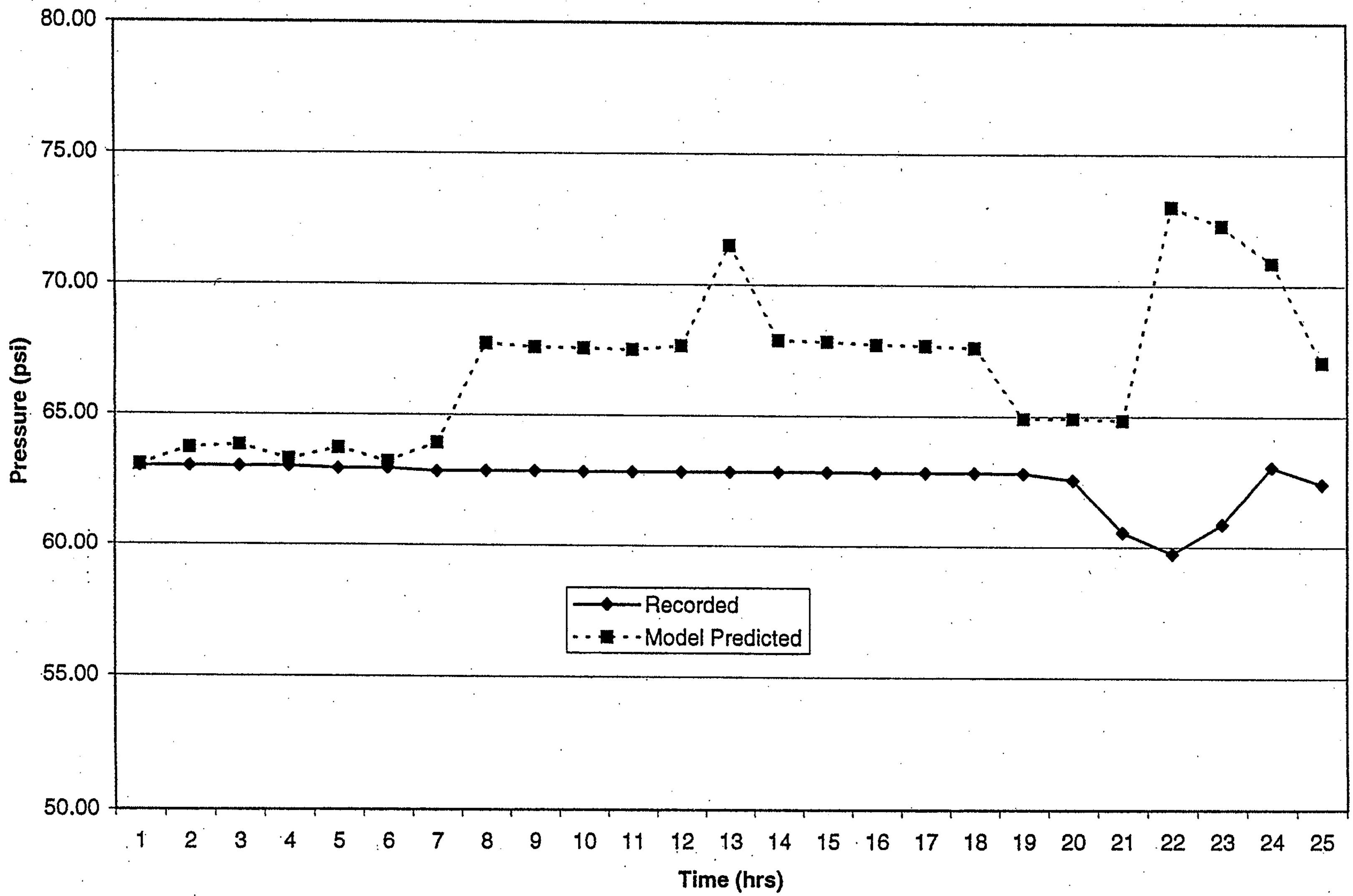


Figure 2G: Dynamic Pump Station
River View Tank Recorded Vs Predicted Pressure

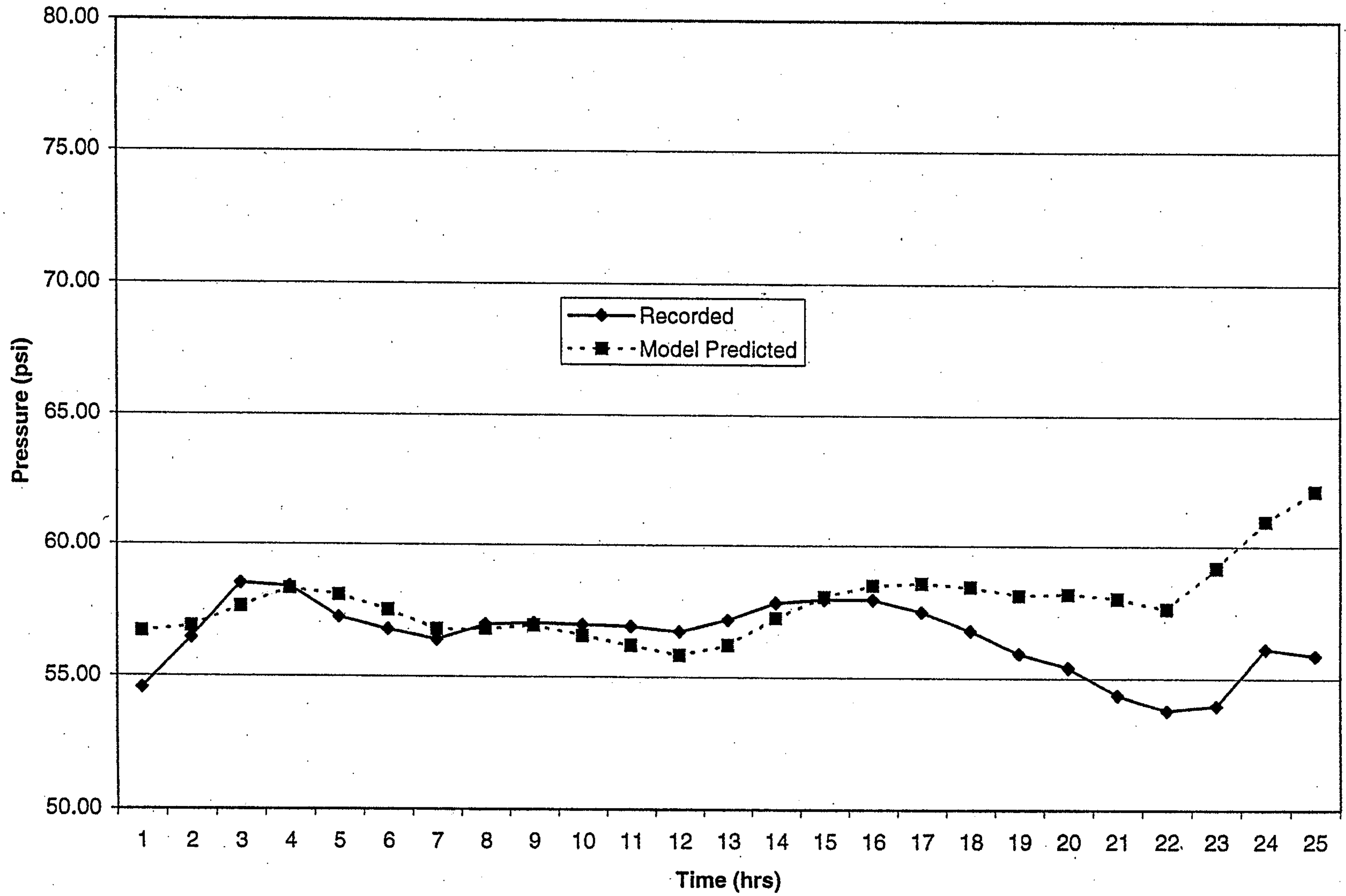


Figure 2H: Dynamic Pump Station
South Tank Recorded Vs Predicted Pressure

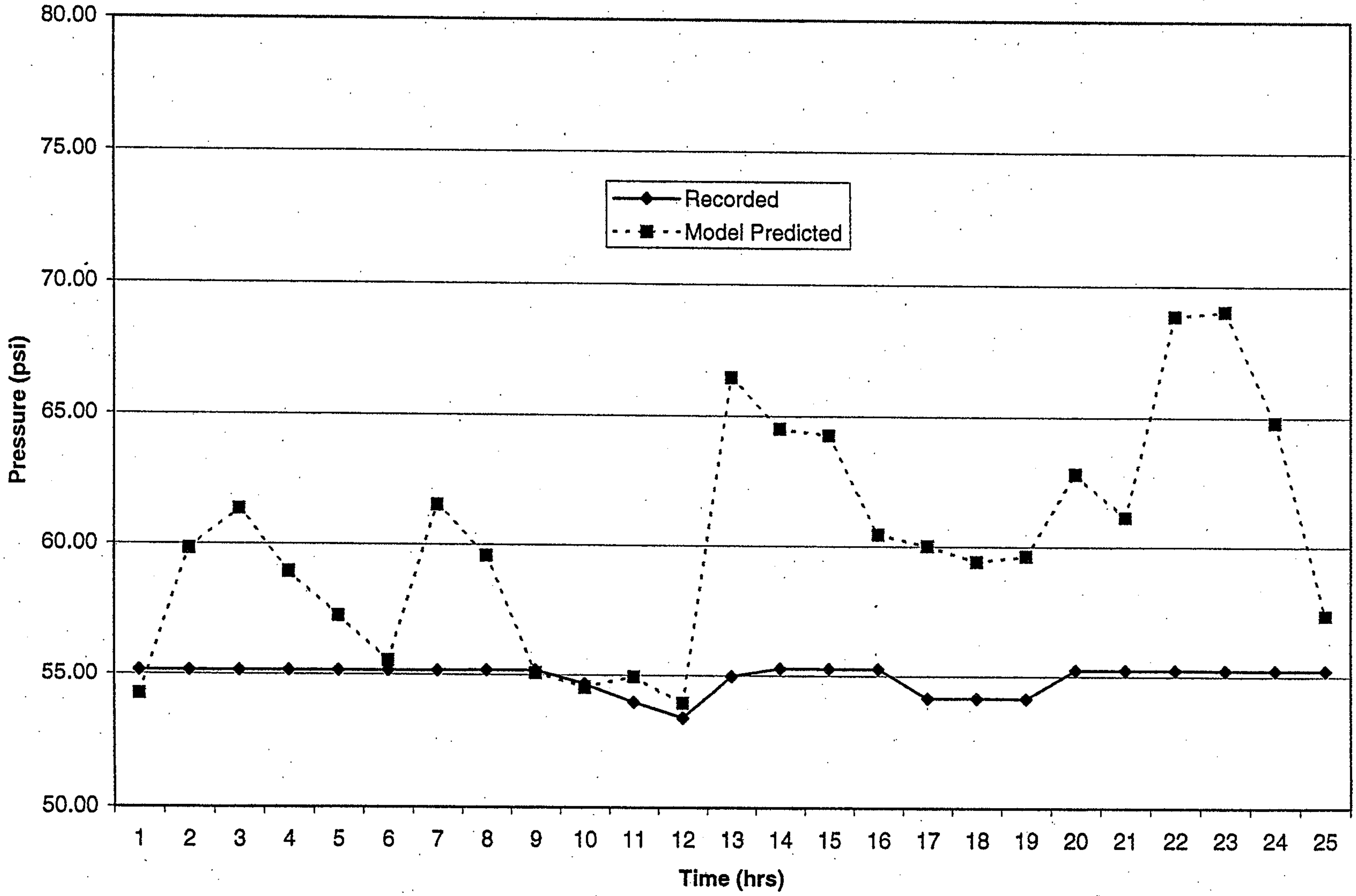


Figure 2I: Dynamic Pump Station
Benham Tank Recorded Vs Predicted In/Out Flows

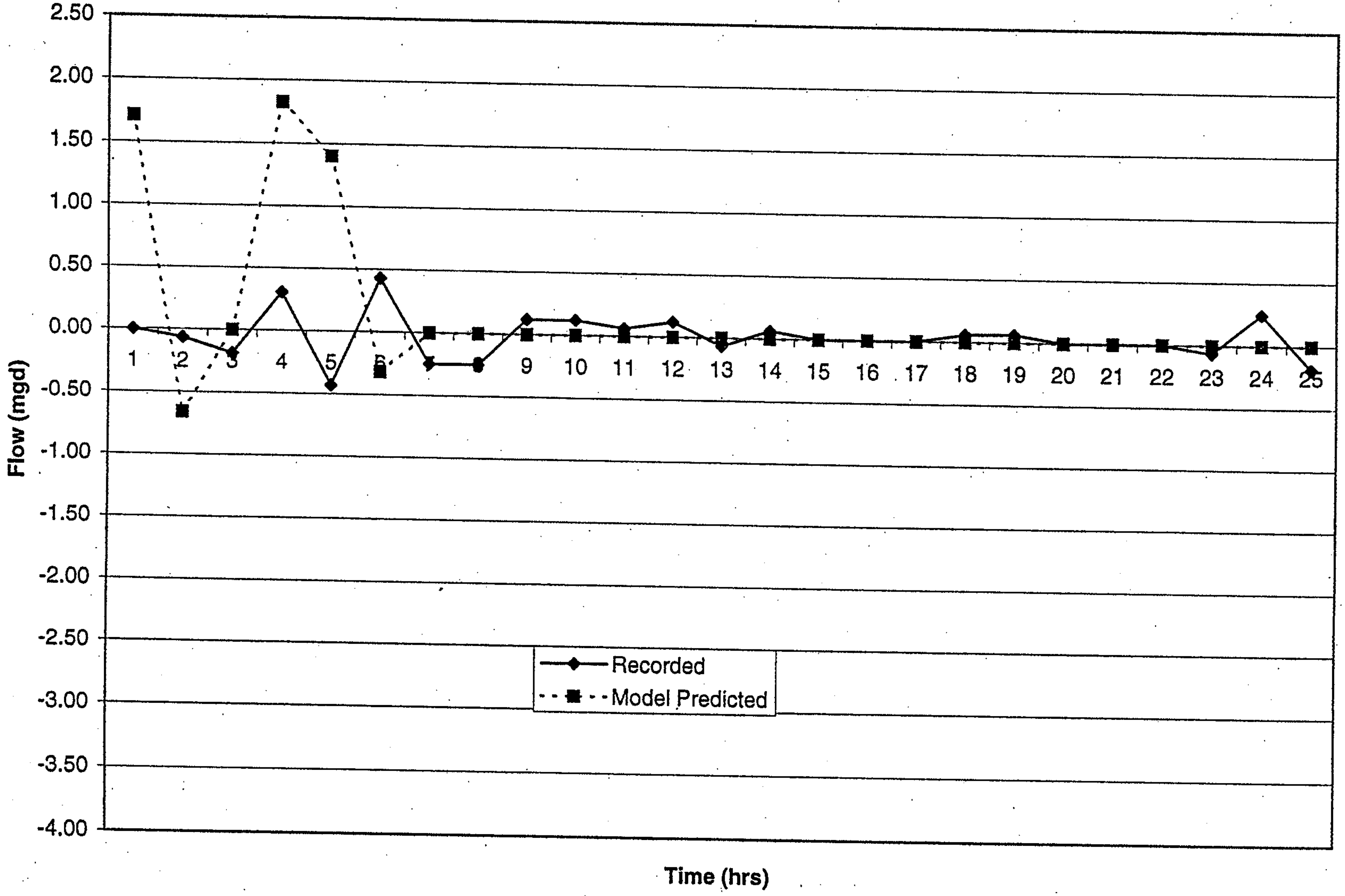


Figure 2J: Dynamic Pump Station
Bower Tank Recorded Vs Predicted In/Out Flows

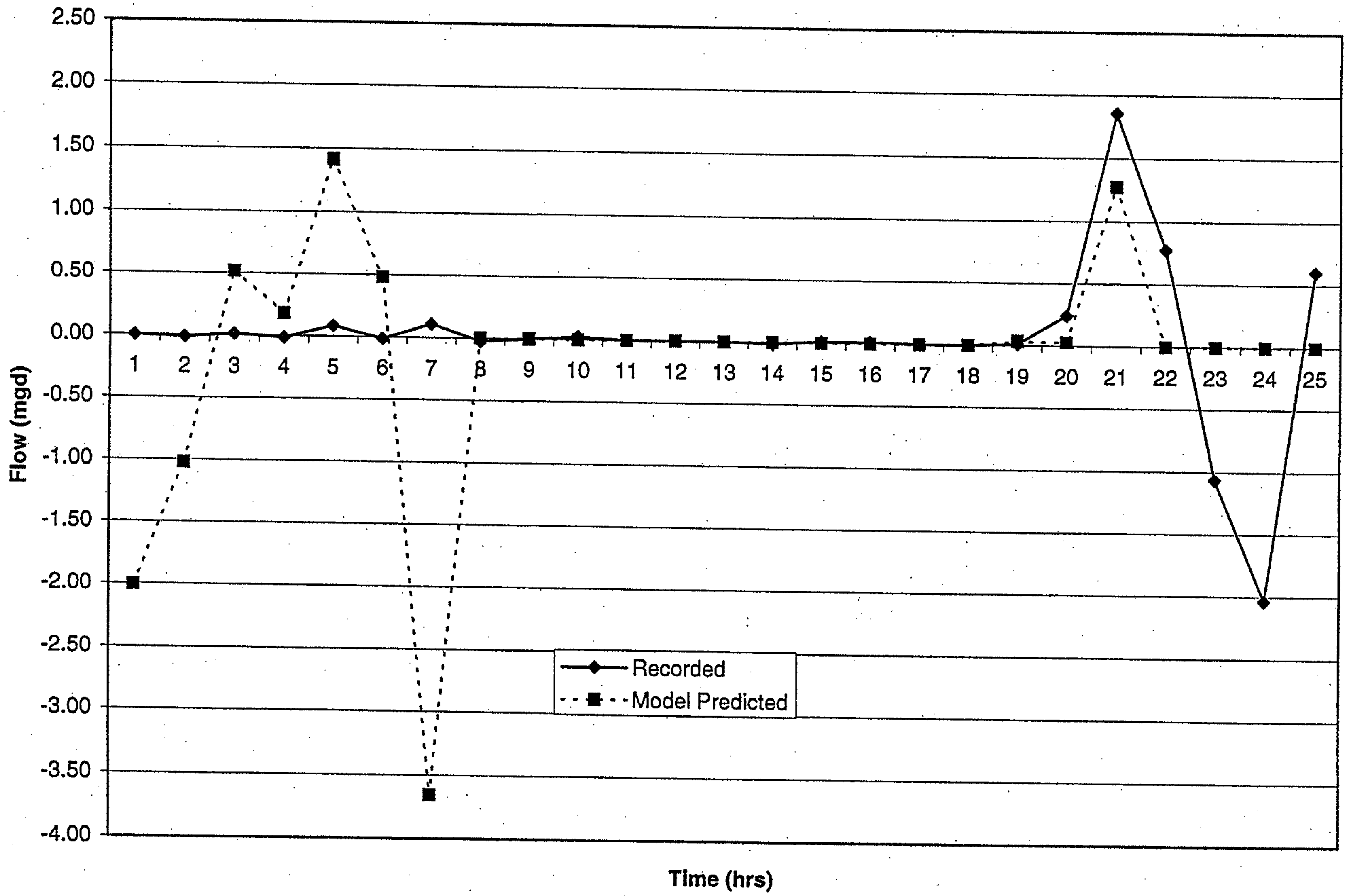


Figure 2K: Dynamic Pump Station
RiverView Tank Recorded Vs Predicted In/Out Flows

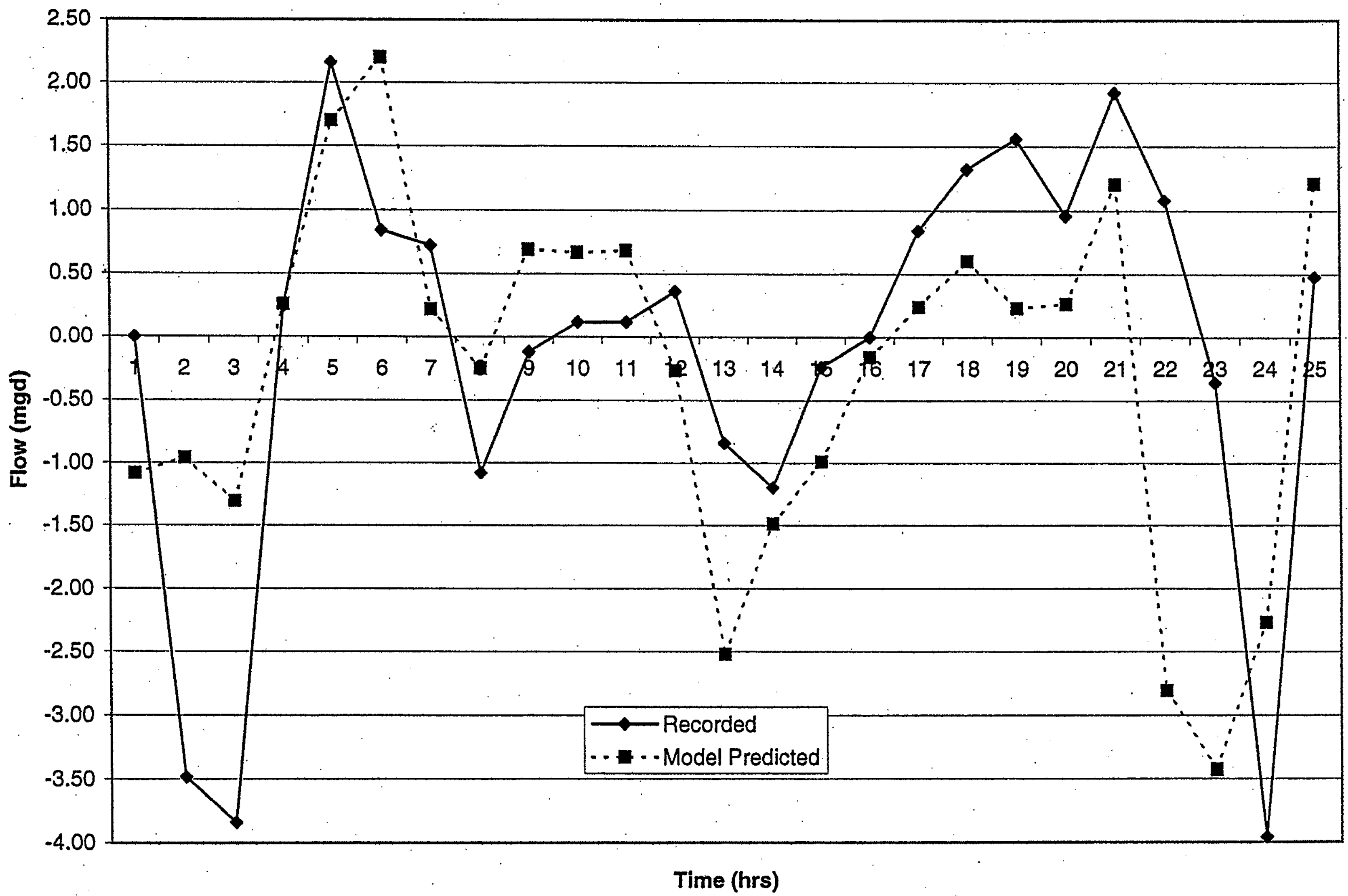
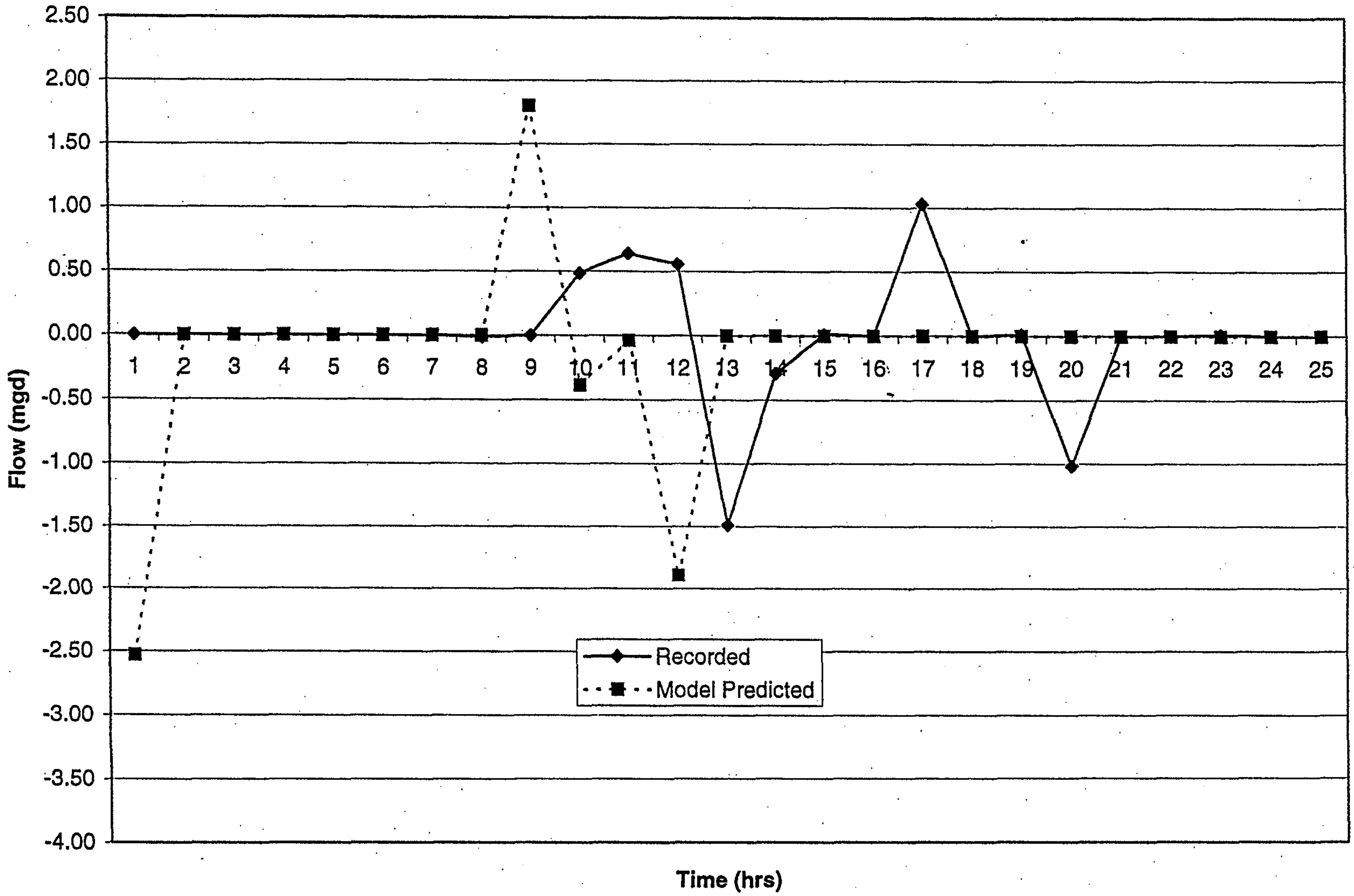
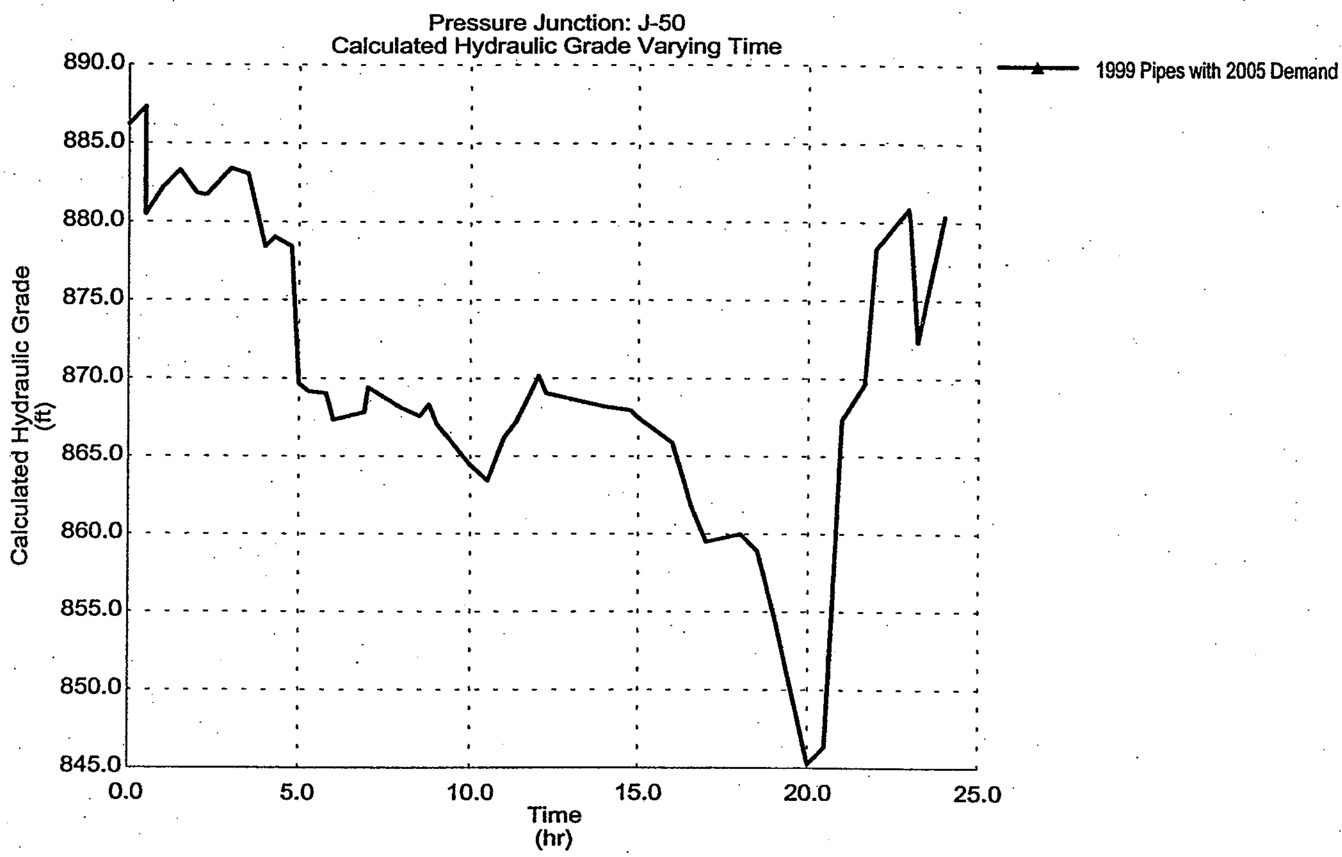


Figure 2L: Dynamic Pump Station
South Tank Recorded Vs Predicted In/Out Flows




Pressure Junction: J-50
Calculated Hydraulic Grade Varying Time
890.0
885.0
880.0
875.0
870.0
865.0
860.0
855.0
850.0
845.0
Calculated Hydraulic Grade
(ft)
0.0
5.0
10.0
15.0
20.0
25.0
Time
(hr)
1999 Pipes with 2005 Demand

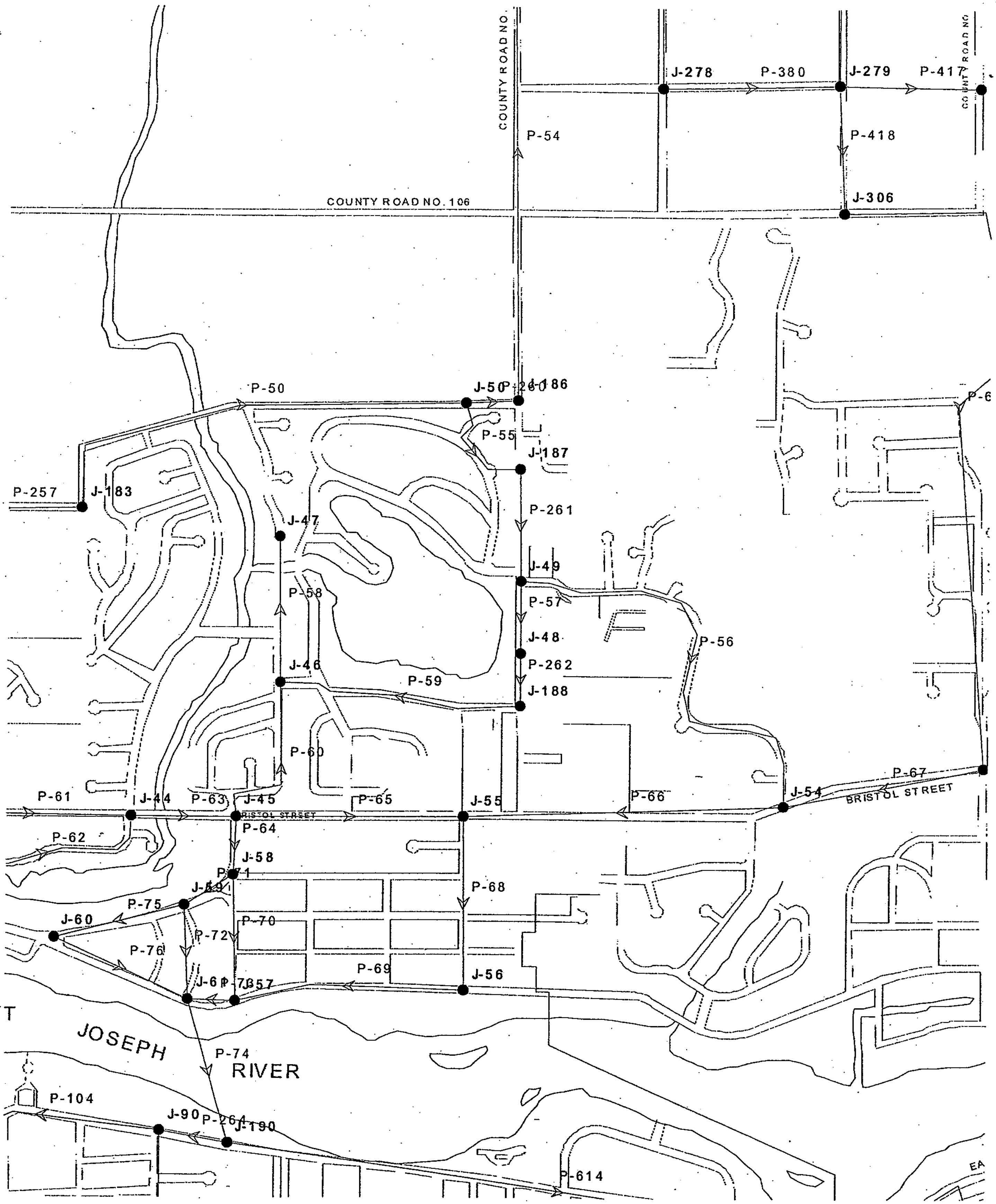
Scenario: 1999 Pipes with 2005 Demand
Extended Period Analysis: 0.00 hr / 24.00
Junction Report

Label	Elevation (ft)	Zone	Type	Demand (gpd)	Pattern	Demand (Calculated) (gpd)	Calculated Hydraulic Grade (ft)	Pressure (psi)
J-49	765.00	Zone-1	Demand	183,549	General	85,350	885.48	52.23
J-55	762.00	Zone-1	Demand	122,477	General	56,952	885.15	53.39
J-44	751.00	Zone-1	Demand	119,330	General	55,488	885.95	58.50
J-187	762.00	Zone-1	Demand	114,978	General	53,465	885.71	53.63
J-46	756.00	Zone-1	Demand	94,241	General	43,822	885.19	56.01
J-47	751.00	Zone-1	Demand	93,018	General	43,253	885.18	58.17
J-45	755.00	Zone-1	Demand	68,873	General	32,026	885.19	56.44
J-50	762.00	Zone-1	Demand	29,908	Composite	13,067	886.16	53.83
J-188	761.00	Zone-1	Demand	21,767	General	10,122	885.41	53.93
J-48	755.00	Zone-1	Demand	11,754	General	5,465	885.46	56.56
J-186	759.00	Zone-1	Demand	7,456	Composite	3,396	886.13	55.11
J-183	763.00	Zone-1	Demand	0	General	0	886.69	53.62

Scenario: 1999 Pipes with 2005 Demand
Extended Period Analysis: 0.00 hr / 24.00
Mike's Pipe Report

Label	From Node	To Node	Length (ft)	Diameter (in)	Hazen-Williams C	Control Status	Discharge (gpd)
P-50	J-183	J-50	3,830.00	20	100.0	Open	880,209
P-55	J-50	J-187	1,100.00	12	90.0	Open	373,349
P-57	J-48	J-49	800.00	12	90.0	Open	-74,617
P-58	J-46	J-47	1,220.00	12	90.0	Open	43,253
P-59	J-46	J-188	2,270.00	8	90.0	Open	-59,030
P-60	J-45	J-46	1,610.00	12	90.0	Open	28,046
P-63	J-44	J-45	900.00	12	90.0	Open	550,075
P-65	J-45	J-55	2,130.00	12	90.0	Open	73,621
P-260	J-50	J-186	630.00	20	100.0	Open	493,794
P-261	J-49	J-187	750.00	12	90.0	Open	-319,885
P-262	J-48	J-188	400.00	8	90.0	Open	69,151

Scenario: 1999 Pipes with 2005 Demand



MALCOLM PIRNIE

INTEROFFICE CORRESPONDENCE

To: Art Umble, Manager, City of Elkhart, IN **Date:** 12/17/2001
Michael Machlan, Network Engineer, City of Elkhart, IN

Copy: Melissa Moran, Malcolm Pirnie, Indianapolis, IN

From: Chris Ranck, Indianapolis, IN

Re: Future Conditions Modeling Assumptions

This technical memorandum outlines the assumptions made in the development of a future conditions WaterCAD model.

1.0 MODELING WELL FIELDS AS INFINITE SOURCES

For the future demand conditions, all well fields were modeled as an infinite source. This approach allows water to be distributed from the well fields in the most energy efficient manner. At the same time this method helps establish the degree of reliance that the system places on each source. It also assumes that the high service pumping capacity for a given pump station or well field does not limit the system.

Infinite sources were developed in the WaterCAD model by connecting a reservoir to the discharge point in each well field; three reservoirs were used in the North Main Street Well Field to accurately depict its complexity. Flow from the reservoirs was controlled with a pressure-reducing valve (PRV) that was designed to match the observed hourly pressures for the maximum day event of June 9th, 1999.

When modeling future demands, the operating pressures for the PRV's were adjusted so the water could be supplied without exceeding the well field's feasible firm capacity. This analysis assumed that the hourly observed pressure at the well fields would have similar characteristics to that of the observed max day.

The proposed new Northeast Well Field was modeled with a constant operating pressure of 55 psi; this allowed the distribution system determine its diurnal pattern of water delivery.

2.0 EXISTING DISTRIBUTION SYSTEM AND STORAGE ELEMENTS

No modifications to the existing distribution system and storage elements were made during the modeling of future conditions. Please consult the technical memorandum City of Elkhart Water Distribution System Model Information Review and Calibration (Malcolm Pirnie, 2000) for more information.

3.0 MODELING NEW STORAGE ELEMENTS

New storage elements were sized based on their equalization requirement as reported in the Water Master Plan Executive Summary (Malcolm Pirnie, 2001) and modeled to effectively float on the system during a maximum day event. The desired operation would begin filling between midnight and 4:00 AM, draining from 4:00 AM to 10:00 PM, and filling for the remainder of the simulation.

Section 11
Appendix D

Technical Paper

UTILIZING GIS IN DEVELOPING REALISTIC DEMAND DISTRIBUTIONS TO SUPPORT MODELING IN WATER SUPPLY MASTER PLANNING

Art K. Umble[1], Melissa Moran[2], Tarlochan Bhullar[2], Michael C. Machlan[1]

Abstract

Computer models that predict the hydraulic performance of a distribution system are powerful tools that can be used to help utilities make decisions about future improvements to their water systems. In 1999, the City of Elkhart initiated a project to take the existing model of their distribution network and develop a planning-level model that would enable capital improvements planning.

Developing a fully calibrated network model is a multi-step process; this process is described in the flow diagram presented on Figure 1. In this project, the City of Elkhart proceeded with development of a planning-level model; the work necessary to achieve a fully calibrated model has not been completed and is planned as a future project.

The purpose of this paper is to present an innovative approach to allocating water demands within the model network. This demand allocation process, while imperfect, was successful enough to allow Elkhart to proceed with planning-level decisions prior to developing a fully calibrated model.

Traditional approaches to projecting water consumption demands focus on population projections in conjunction with land use and zoning information derived from census bureau data, local housing authorities and municipal and regional planning agencies. Unfortunately, such data often requires subjective interpretation due to inconsistencies in the data, over-consolidation of the data, or the age of the data (i.e., outdated).

In support of the hydraulic model used as a water master planning level tool only, the City of Elkhart has developed its water demand distributions using demand data derived from actual billing records over the past several years. Incorporating a state-of-the-art Geographical Information System (GIS) *geocoding* feature, actual usage rates corresponding to specific customer addresses were assigned to specific point locations throughout the distribution system at corresponding address points in Elkhart's GIS. Demands were then assigned to specific WaterCAD® model nodes through logical grouping assignments using GIS polygons. The result provided existing realistic demand distributions for rapid and reasonable model development for capital planning purposes.

Keywords: GIS, master planning, modeling, water demand

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[2] Malcolm Pirnie, Inc., 8440 Woodfield Crossing Blvd., Indianapolis, IN 46240

Introduction

Choosing a methodology for estimating water demand is critical to the usefulness of the hydraulic model used for the master planning work. Traditionally, once the demands are estimated from the land use generalizations, a system distribution model is constructed and calibrated to the local conditions. This can be a challenging task, requiring significant amounts of field testing for flow and pressure, not only for the model development, but also in the on-going model updates and maintenance. An iterative process is then employed in which the demands and other parameters, such as pipe roughness, are adjusted to match field data. If a method is employed where model inputs for demand allocations reflect *actual* demand distributions within the specific community under study, then calibration efforts should be reduced, should be reasonably accurate, and enhance confidence in the long-term demand distribution projection. Such efforts have been considered by others (Dziegieliewski and Boland, 1989). This approach should result in a planning level model that provides the roadmap for implementing a capital improvement program. Such was the goal for the City of Elkhart.

Methodology

In 1999, the City of Elkhart decided to update its 13-year old water master plan. The hydraulic model used to conduct the update was WaterCAD®[1]. A combination of methods was used to allocate demands within the model network. The critical tool driving the demand distribution input to the model for existing water demands was use of the Geographic Information System (GIS), ArcView[2] module. Development of future

[1] Developed and marketed by Haestad Methods, Inc.
[2] Developed and marketed by ERSI

water system demands was conducted using land-use projections and per-customer water usage data from a recent water audit; however, the calculation and allocation of the future demands is not the subject of this paper. Instead of using conventional models for estimating the existing system water demand, it was decided that records of actual water usage would more accurately characterize Elkhart's water use and how its demand is distributed within each sector (residential, commercial, industrial, governmental, etc.). Other researchers have investigated similar methods (Basford and Sevier, 1995; Buyens, et al., 1996; Cesario and Lee, 1980; Coote and Johnson, 1995; Stern, 1995). Billing records corresponding to metered water consumption data for the years 1996-1999 were acquired. These records provided actual usage rates per individual metered user. A matrix showing the relationships between the data set and their function in the project is given in Table 1.

Table 1: Data Set and Source Relationships

Data Set	Use of the Data	Data Set Source
Metered Consumption	Customers' addresses for geocoding; demand for each customer	Utility Data Corporation (UDC)
Elkhart address coverage (GIS)	Base map of streets to which customers could be geocoded	City of Elkhart
Model node & Demand polygons	Associate customer points and associated demands with model nodes	Malcolm Pirnie, Inc.

The allocation of metered consumption to the model nodes followed three basic steps: 1) geocoding, 2) computation of average demand for each customer, and 3) a spatial join of the data (aggregating demands by node). The process used customer addresses to link the metered consumption database to the Elkhart GIS coverage. The GIS geocoding process allocated the demands for each metered customer on the distribution system network to its appropriate geographic location (i.e., to an x-y coordinate). The result was the placement of a point in the GIS theme that represented a "match" with the customer's record for that address location. The geocoding locations were set within Elkhart's street right-of-way grid which corresponds to the tap for the customer rather than the building location..

The geocoding process "split" the original data set into two parts: those records that found an address match and those that did not. In the initial geocoding process, of the total 17,576 records, 13,654 (78%) were matched to a GIS address, while 3,922 were not. In general, those records not finding a match represented those customer addresses located outside the GIS address database (the Elkhart GIS coverage currently reaches only to the city's corporate limits). The City provides water service to some areas in the county which are contiguous--or nearly so--with the city. These "out-of-limits" records accounted for 3,423 (87%) of the unmatched records. The remaining 499 unmatched records resulted from syntactical errors within the geocoding scheme. For example, in the customer database, an account address may be listed as "1520 Main Street," whereas the Elkhart GIS recognizes only syntax of "1520 N. Main Street." This difference creates an error resulting in an unmatched record. For each matched record, the GIS automatically placed a point onto the GIS theme that represented the customer's location, and tied to that point the customer's water consumption data. Unmatched records had to be placed manually.

The database was further refined to reflect inconsistencies in the metered consumption database itself. Customer records were marked as "valid" when the water consumption corresponded consistently to the specific dates of meter reading. When consistency could not be established, those records were marked as "invalid." An example of an invalid record was when a water use reading contained a zero, or contained no data, but the account was active. After the geocoding and the evaluation of the data contained in the metered consumption database, the result was 12,126 valid demand records (customers) that matched during geocoding and 3,423 valid demand records that did not match during geocoding. The demand from the valid demand records that did not match during geocoding was applied throughout the system as part of the system specific peaking factor that is discussed below. With these refinements, the final geocode scheme reached an 88% success rate (12,126 records plus 3,423 records to be allocated spatially). The remaining 12% of the records contained only 0.3 MGD, or less than 3%, of the daily demand' this demand was not used in the allocation process.

The second step in the demand allocation processes was the calculation of the average demand for each record. In Elkhart, customer meters are read once monthly. Therefore, only the average day during that month could be computed. The data set was then configured to contain the historic peak day, which occurred on June 9, 1999. The historic peak day demand using the hourly system control data was calculated at 16.46 MGD. A proportionality factor was applied to the average demand for each demand point for the month containing the maximum day to reflect the demand of the maximum day. This factor was determined from the hourly pumping records for the maximum day. This assumes, reasonably, that the spatial distribution of demands for the peak day is the same as during the peak month.

Using the water consumption data from the records, the actual demand allocated to each GIS-mapped address could be tallied for high demand season during the summer period average day. The Unaccounted-for-Water due to leakage, meter error, authorized and unauthorized non-metered use was reported at 10.2% of the billed water usage in the Water Audit Report.[3] The billing data analysis for year 1999 reported that the average day system demand during summer months (June through August) including Unaccounted-for-Water was 11.81 MGD. Matched records totaled 7.5 MGD. Unmatched records totaled 3.22 MGD and Unaccounted-for-Water totaled 1.09 MGD. This unmatched demand was later evenly distributed amongst the polygons having areas within them where customers could not be matched by geocoding. Invalid records were also found during analysis and were excluded from the analysis. The typical invalid records were those with an unreasonable billing period. Table 2 below summarizes the results of the geocoding analysis, and Unaccounted-for-Water. Figure 2 illustrates the average day demand calculation procedure using a process flowchart.

Table 2: GIS Geocoding Results

	Matched Records	Matched Demand	Unaccounted for Water	Unmatched Records	Unmatched Demand	Unaccounted For Water
Valid Records	12,126	7.5 MGD	-	3,423	3.22 MGD	-
Invalid Records	1,508	-	-	499	-	-
Record Totals	13,654	7.5 MGD	0.76 MGD	3,922	3.22 MGD	0.33 MGD

The third step in the demand allocation process was a GIS function known as a "spatial join." In this exercise, demands associated with individual address points were grouped and applied to a specific point, or node, in the water distribution system. The groupings were determined by identifying an area, or polygon, that draws its water supply from the same major branch of the distribution network. Individual demands from each address point (x-y coordinate) located within the boundaries of each polygon were summed to a combined demand using spatial join. These combined demands were

[3] Water Audit for Elkhart, Indiana: Pitometer Associates, Inc., Sept. 1999

represented by the creation of an area polygon around the distribution node. The result was a GIS polygon theme, with each polygon tied to the demand allocated to an individual node. These distribution nodes corresponded to nodes within the WaterCAD® hydraulic model. Figures 3 and 4 illustrate the steps outlined above for allocating the demand within GIS and for setting the stage for the WaterCAD® simulations. Figure 3 illustrates the geocoding placements of address (customer account) records in a detailed section of the City's downtown urban core. Figure 4 shows the superimposition of the grouped customer demands to model node points, encompassed by the corresponding demand polygons. Figure 5 overviews the WaterCAD® model for the distribution network as it relates to Elkhart's GIS layout.

The WaterCAD® model consists of 622 pipe segments, connected and looped by 458 model nodes. Data input for the model was derived directly from the GIS demand allocation scheme as detailed above. Water supply inputs to the model occur at three locations, corresponding to the three existing well field facilities. Initial model runs were made with single inflow inputs at these locations, followed by more detailed modeling of the high service pump stations.

As described above, average daily demand was determined from monthly meter readings for June 1999. The diurnal usage pattern applied to the nodes was derived from hourly pumping records for well field and storage tank flow for the maximum day, June 9, 1999. Preliminary model runs were then conducted by simulating the system's response during the 24-hour duration of that maximum day, then the outputs for those model runs were compared with actual hourly pumping records for that day. A residential diurnal characteristic developed from actual known data from the maximum day was applied throughout the system wherever residential demand was present. This accounted for approximately 98% of the allocation. For the remaining 2%, which represented commercial, a generic diurnal characteristic was applied.

Results and Discussion

A major challenge in any modeling effort is the calibration phase, and significant resources can be expended. Calibration is at the core of water distribution model development. One must be cognizant of calibration methodology and degree of calibration effort necessary when considering the model's intended use. In this work, the model was developed as a tool only for master planning to provide utility managers a general roadmap for the future. A flow and pressure comparison was made by comparing model output (i.e., simulated system performance) to system control data for flow and pressure at three source locations (wellfield pump stations - see Figure 6) and pressure data at three additional locations scattered in the distribution system. While these comparisons, even when accurate, do not constitute a calibrated model, the City of Elkhart was comfortable proceeding with capital improvement planning provided that the model runs resulted in reasonably similar system performance at the selected locations.

The initial WaterCAD® model runs examined two case conditions: 1) system inflows based on point inputs at the wellfield pump stations (i.e., the inflow at the pump stations was fixed at the correct flow rate and modeled pressures at the pump discharge were compared to actual pump discharge pressures), and 2) inflows based on actual modeled high service pump inputs (i.e., the actual pump curves were entered into the model and the modeled pressures at the pump discharge were compared to the actual pressures). These simulations cover the hourly record for the 24-hour period shown for the maximum day that occurred on June 9, 1999. The system demand responses are shown first in Figure 7, with the comparison between actual and modeled conditions being excellent. Since system demands are nodal inputs, the *actual* versus *modeled* response for both cases are the same. Figures 8 through 11 are results of system pressure for the *actual* versus *modeled* simulations at the Northwest and North Main Street Wellfield locations, respectively, for the same two cases.

For the Northwest Wellfield, in both cases, the major differences occur between 4 and 8 AM and at 10 PM. For the North Main Street Wellfield location, the pressure variances are greater in the run with the details of the pump station modeled, and these differences begin to diverge after about 6 AM (Figure 11) but still within acceptable ranges for a planning-level model. These differences can best be attributed to complexities in attempts to use manufactured supplied pump curves. The decision to use manufacture's supplied pump rating curves and pressure data in the distribution system for model calibration was driven by the model development/calibration cost and the model's intended use. Because master planning was the intended end-use for this model at this stage of its development, this choice is justified. However, as Elkhart proceeds with the development of a fully calibrated model, these pump curves will be evaluated (and will potentially have the pumps tested) to develop a better understanding of why these differences between the actual conditions and modeled simulations exist.

The overall variations illustrated in the above figures are tabulated in Table 3 for the two cases observed. The average differences are within standards for planning level pressure-calibrated hydraulic models.

Table 3: Error differences between actual conditions and modeled simulations

	System Demand (MGD)			Northwest Wellfield (Pressure, psi)			N. Main St. Wellfield (Pressure, psi)			South Wellfield (Pressure, psi)		
	Avg Error	Max Error	Min Error	Avg. Error	Max Error	Min Error	Avg Error	Max Error	Min Error	Avg Error	Max Error	Min Error
Point Inflow	-0.19	-7.73	+0.10	-4.11	-18.14	+0.38	-0.36	-17.42	+0.10	-1.57	-10.74	+0.11
Pumped Inflow	-0.19	-7.73	+0.10	-1.69	-11.06	-0.60	+3.48	+13.46	+1.25	+1.24	+13.05	-0.73

The pressure differences indicated, though perhaps less than acceptable for preliminary design efforts, are acceptable for master planning efforts (within 10%). Obviously, field verification of flow and pressure (by actual measurements of C-factors) is appropriate and necessary when entering design phases.

A major advantage to utilizing the GIS geocoding methodology to allocate consumption demand in conjunction with the WaterCAD® package was a reduction in demand allocation effort. The financial and time resources required for this method are on par with that for traditional model development procedures (i.e., balancing demands based on land use categories with flow and pressure data collected from the field). However, the need for re-calibrations will be reduced as Elkhart proceeds with development of a fully calibrated hydraulic model of our distribution system. Consequently, the City of Elkhart should realize significant savings as the model development process continues.

Conclusions

Allocating demands for water consumption has conventionally utilized demands linked to land use and use density projections. This creates a challenge in achieving a relatively accurate allocation of current supply needs, and in achieving relatively accurate simulations of distribution performance needed for evaluating improvements to the system to meet the changing needs of the system. For the update of the water master plan for the City of Elkhart, a method was developed to promote efficiency in the modeling calibration effort of current system conditions and to support the future demand projections. This method utilized the GIS geocoding feature for linking actual customer addresses to their specific water consumption patterns. By applying actual usage data, the demands for input into the hydraulic model were much more accurate and resulted in reasonable system simulations from the outset for use in the capital improvement planning phase. The authors recognize that model calibration refinement is an ongoing process. As the planning phase moves into preliminary design of infrastructure and ultimately to water quality issues, stricter calibration standards beyond pressure will be essential.

References

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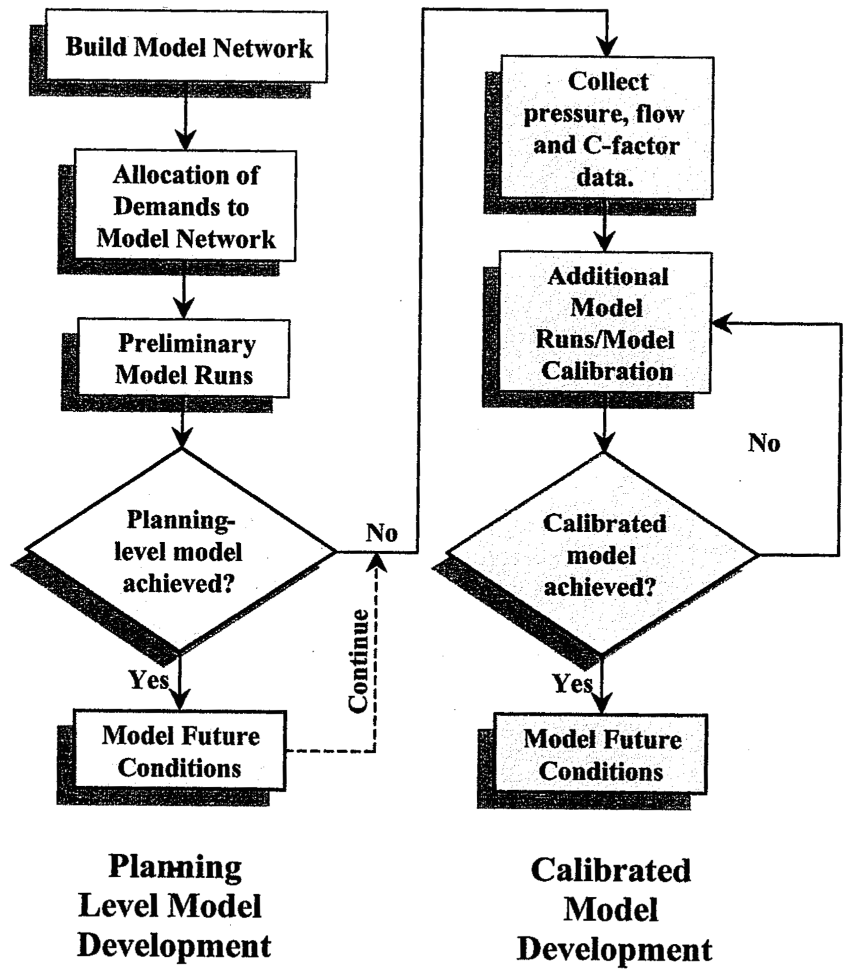

Figure 1: Model Development and Calibration Process

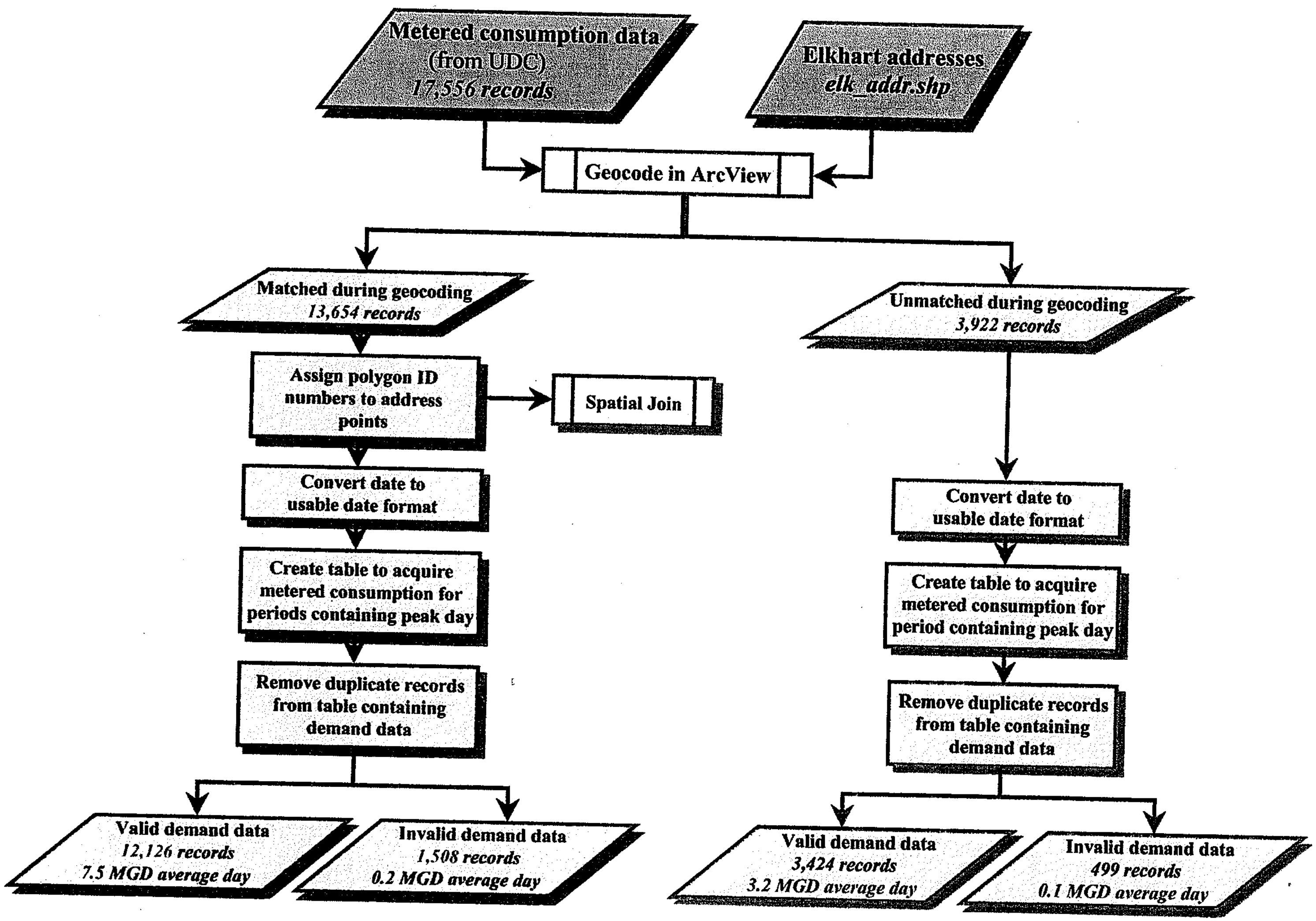

Figure 2: Model Node Demand Allocation Decision Process

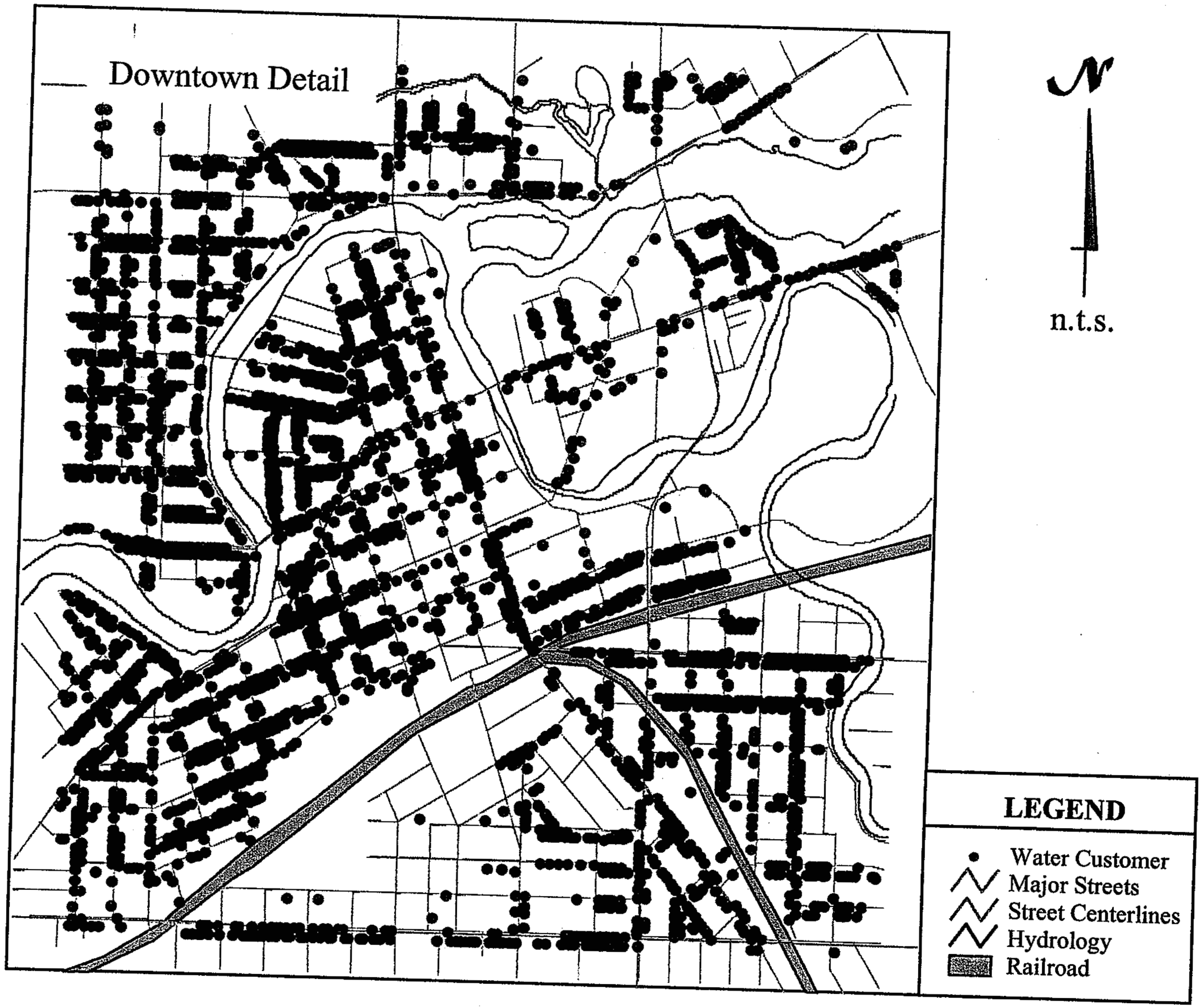

Figure 3: Geocoded Customer Addresses

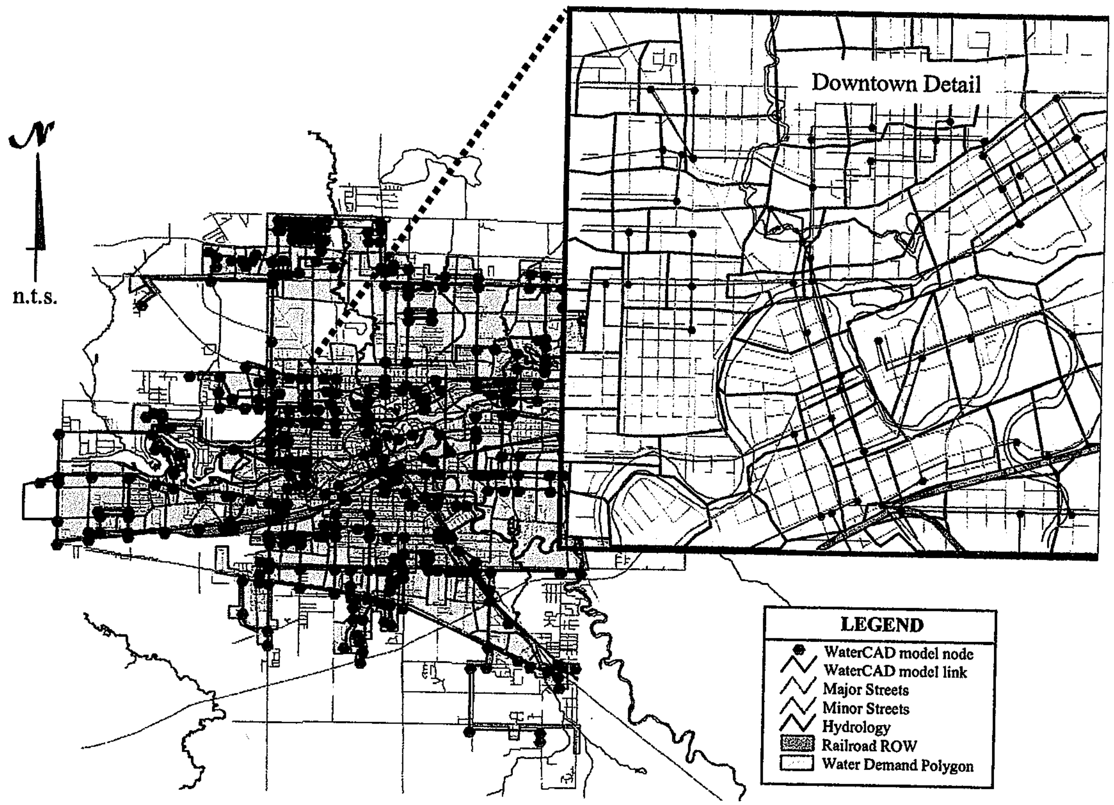

Figure 4: Demand Distribution Polygons

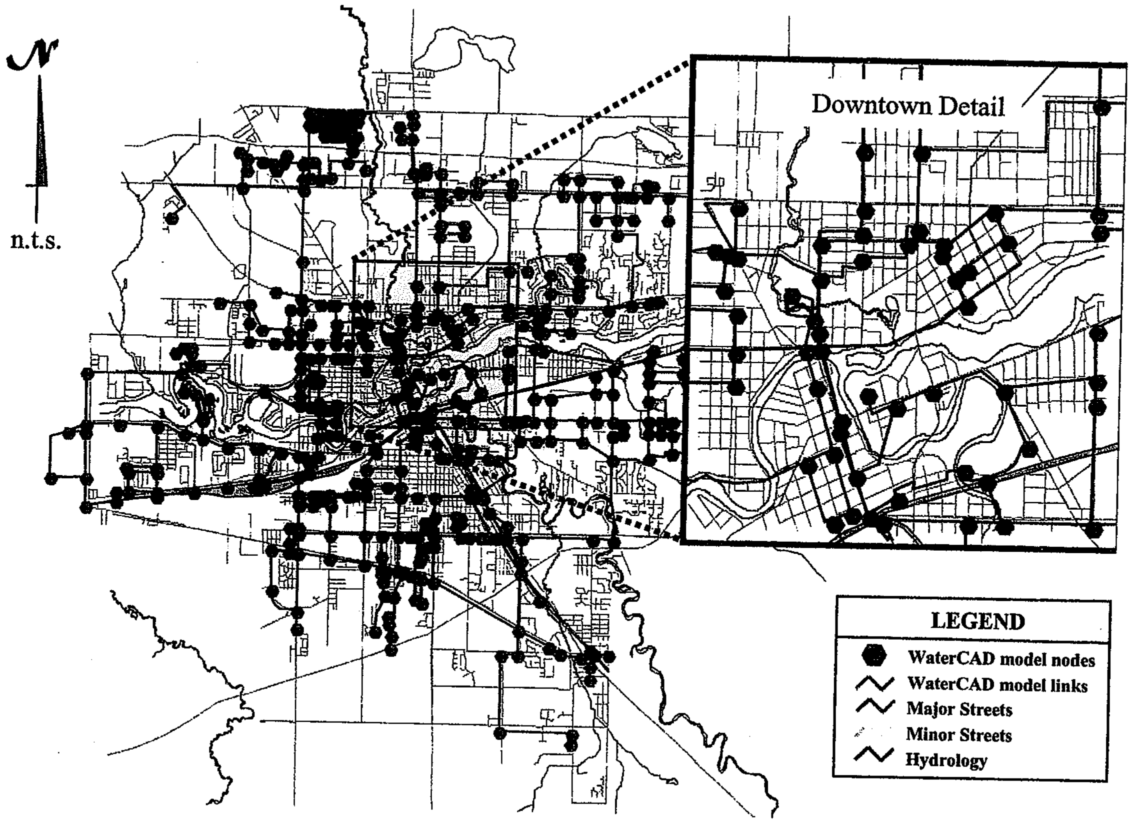

Figure 5: WaterCAD® Model Layout

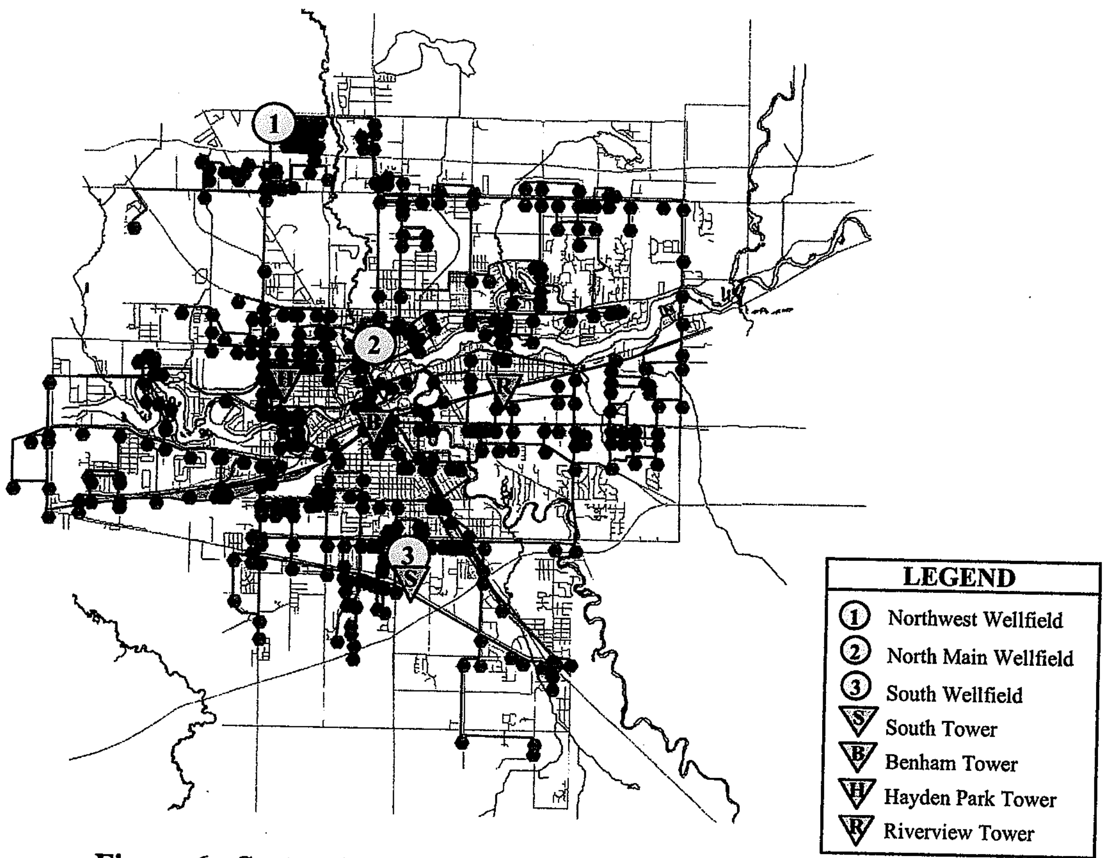

Figure 6: System Points for Pressure Calibration

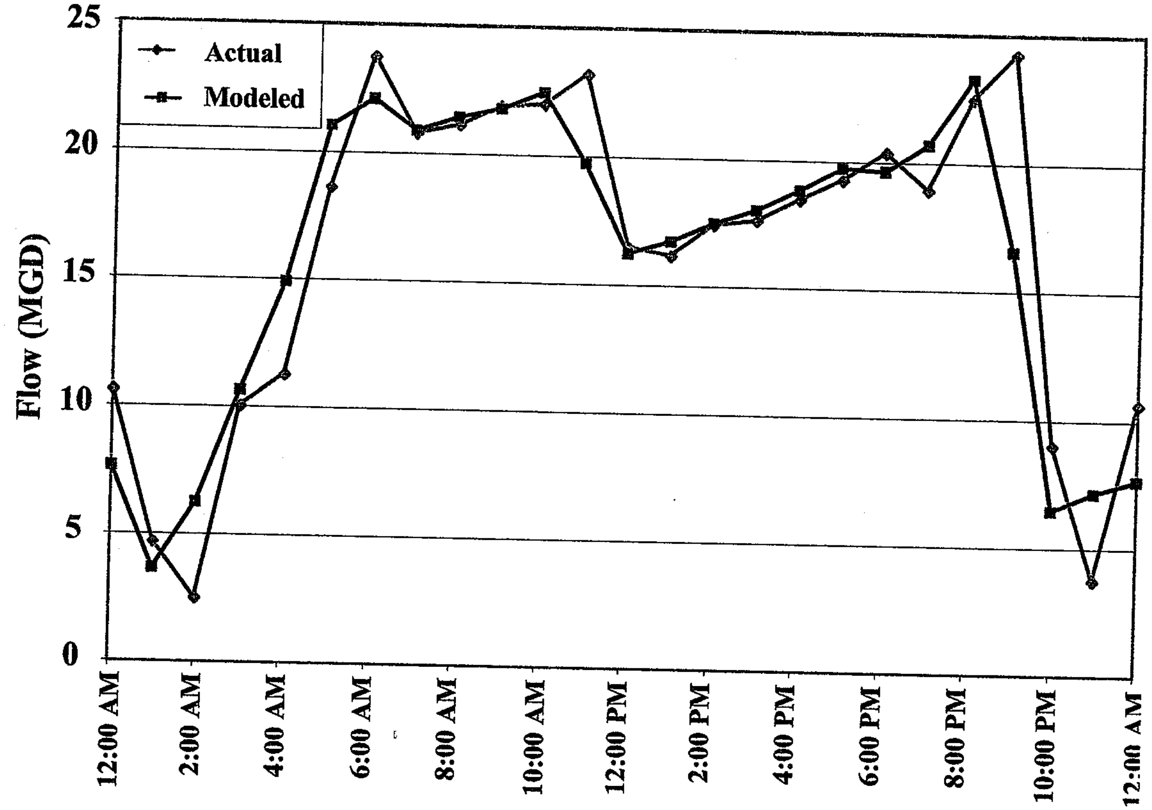

Figure 7: WaterCAD® System Demand Simulation

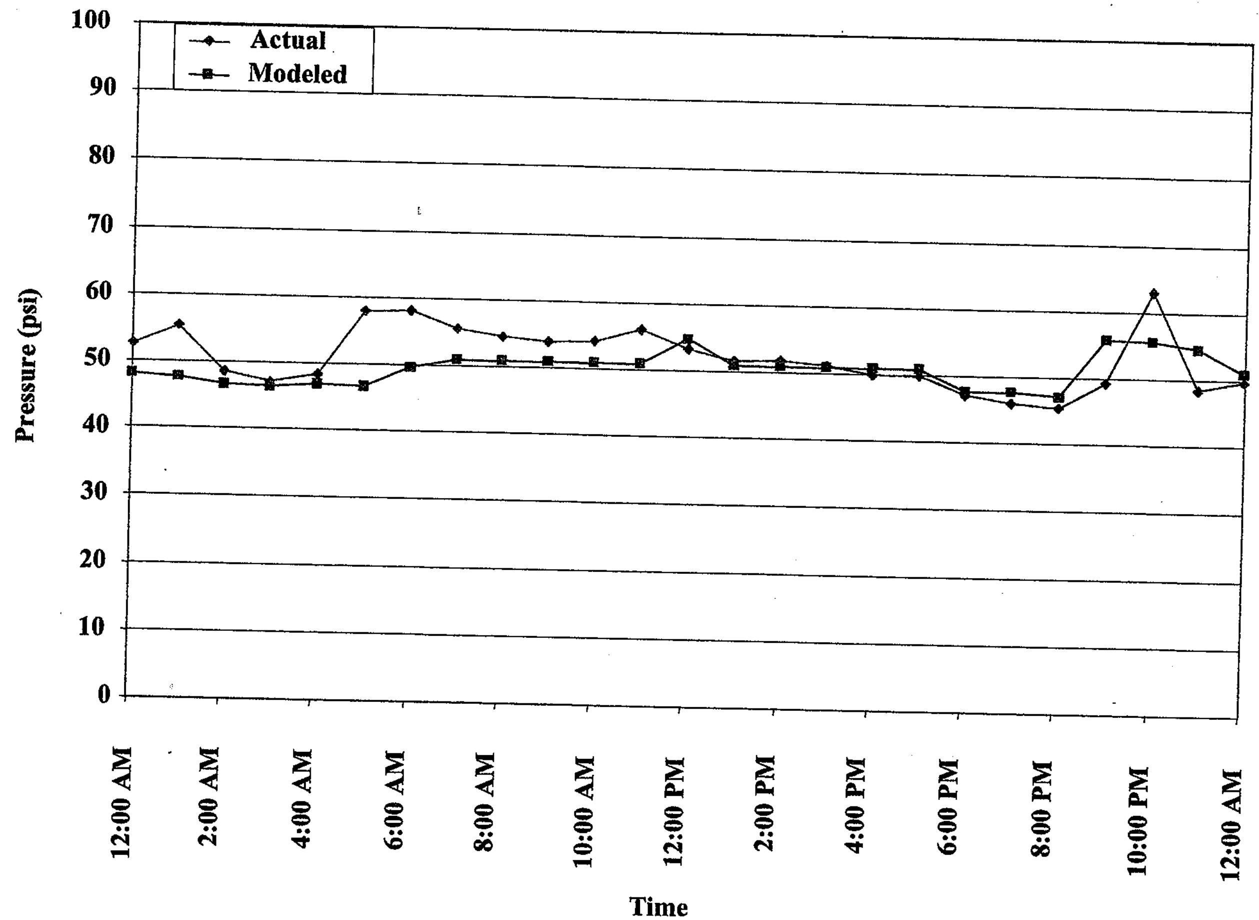

Figure 8: Point Inflow Pressure Comparison - Northwest Wellfield Pump Station

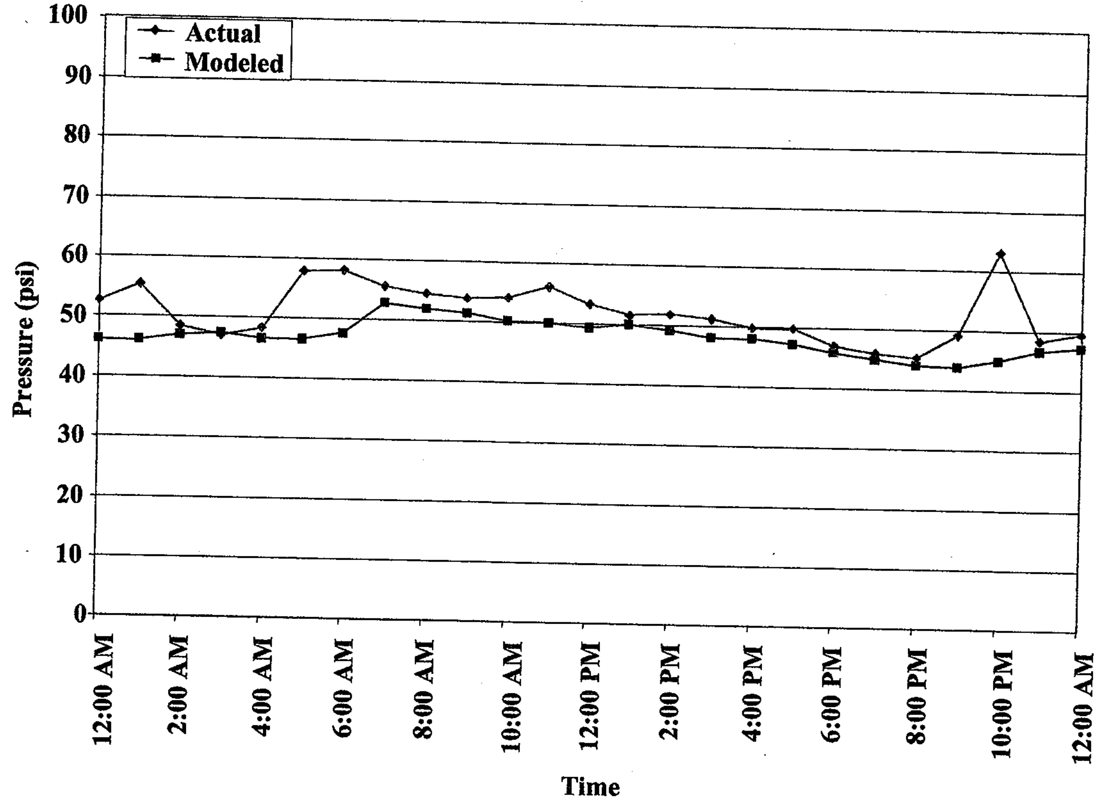

Figure 9: Pumped Inflow Pressure Comparison - Northwest Wellfield Pump Station

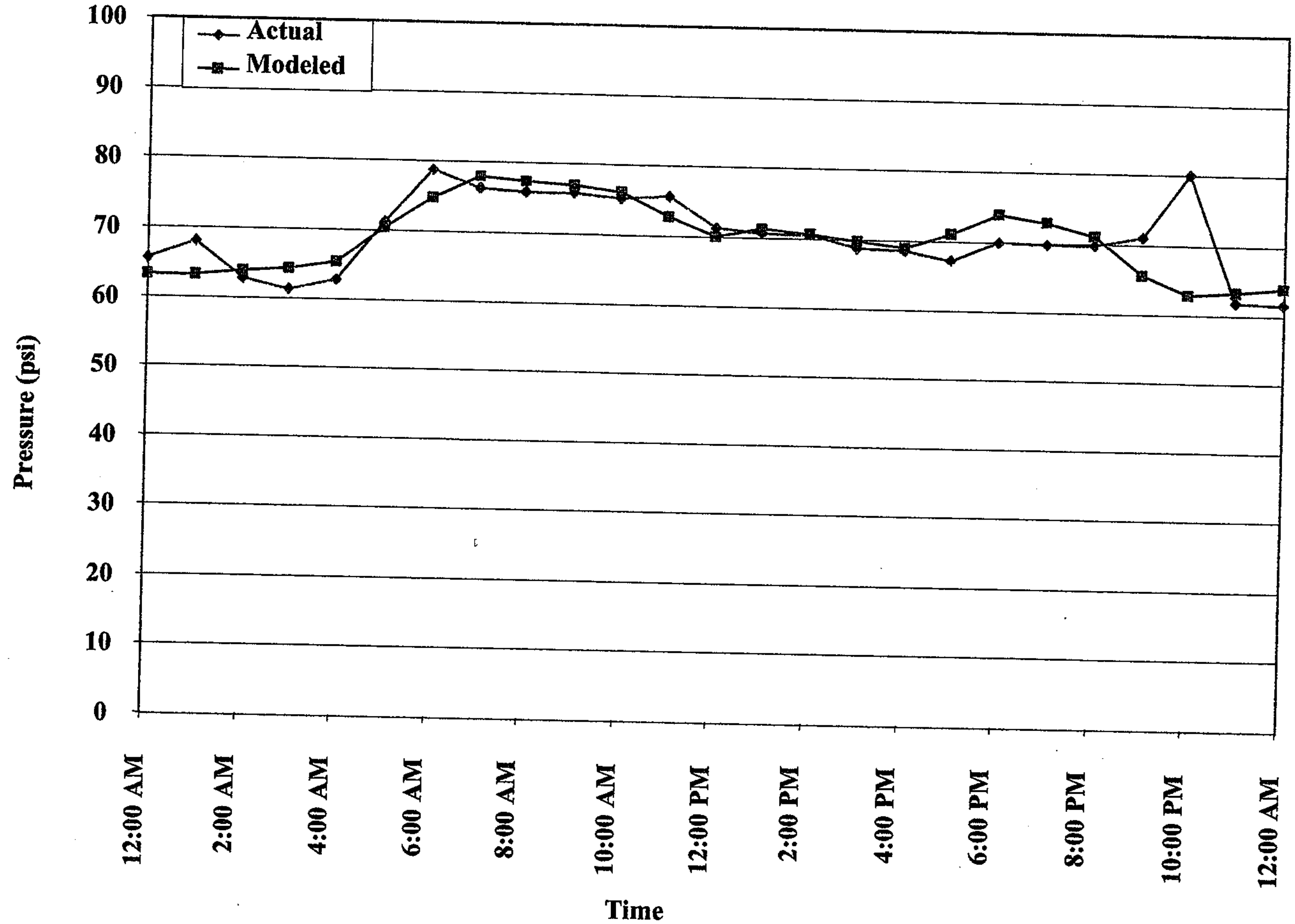

Figure 10: Point Inflow Pressure Comparison - North Main Street Pump Station

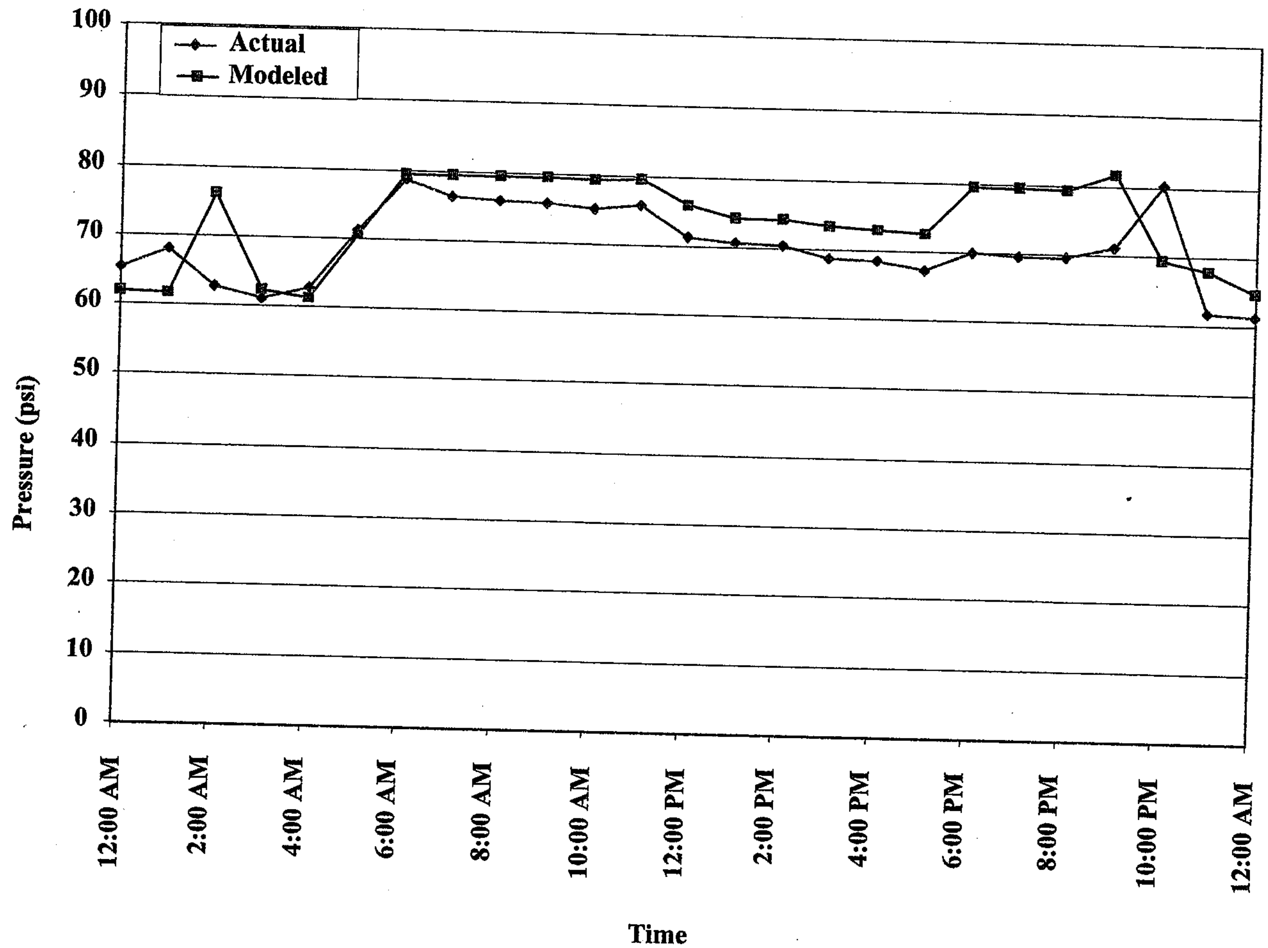

Figure 11: Pumped Inflow Pressure Comparison - North Main Street Pump Station